Nonverbal Synchrony in Psychotherapy: Investigation of a New Approach with the Potential to Better Understand and Predict Therapeutic Success

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Abstract

Patient-focused research aims to enhance psychotherapy outcome by measuring and reporting process variables back to therapists. It has been shown that not only patient-specific characteristics, such as symptom reduction, but also dyadic characteristics, such as the therapeutic relationship, are indicative. A promising new approach concerning the measurement of dyadic characteristics is nonverbal synchrony, which is defined as movement coordination between interacting persons. Nonverbal synchrony is measured objectively and automatically and is therefore free from biases such as selective perception and social desirability. Early studies in social and developmental psychology found relations with social bonding and sympathy. Initial studies in psychotherapy research have found associations with the therapeutic relationship and therapeutic process, suggesting nonverbal synchrony to be a complementary measure of dyadic information that may be used in the future for the early prediction of treatment outcome. The present work summarizes three studies on nonverbal synchrony in outpatient psychotherapy and its relations to therapeutic processes.

In Study I, nonverbal synchrony was measured at the beginning of therapy in a diagnosis-heterogenic sample (N = 143 patients). Using multilevel modelling, the validity of the applied video-based procedures was confirmed. Furthermore, nonverbal synchrony was associated with special outcome types: Patients with non-improvement and drop-out showed the lowest level, patients with non-improvement and consensual termination the highest level and improved patients a medium level of nonverbal synchrony, even when controlling for the therapeutic relationship.

In Study II, nonverbal synchrony and movement quantity were measured at the beginning and the end of therapy and compared between two samples with depressive (N = 68) and anxiety patients (N = 25), respectively. Multilevel modelling revealed lower levels of movement quantity and nonverbal synchrony (when controlling for movement quantity)

in depressive than in anxiety patients at the beginning of therapy. At the end of therapy, both groups reached comparable levels of nonverbal synchrony.

In Study III, nonverbal synchrony was measured at four times of assessment (N = 346 videos) covering a short term therapy in a sample of N = 111 patients with social phobia. Using multilevel modelling, a decrease of nonverbal synchrony during the course of psychotherapy was found. Furthermore, nonverbal synchrony was shown to be a moderator between early response and therapy outcome as the effect of early response on outcome was greater for patients with higher levels of nonverbal synchrony in the early stages of therapy.

1 Introduction

The majority of the patients benefit from psychotherapy, however a substantial proportion does not change, deteriorates or drops out (Hansen, Lambert, & Forman, 2002; Lambert & Ogles, 2004; Mohr, 1995). The aim of patient-focused psychotherapy research is to monitor patient's therapy progress and to report it back to therapists to enhance therapy outcome (Howard, Moras, Brill, Martinovich, & Lutz, 1996; Lutz, De Jong, & Rubel, 2015). This is especially important as therapists are poor at perceiving when their patients are at risk for treatment failure (Hannan et al., 2005; Hatfield, McCullough, Frantz, & Krieger, 2010; Krägeloh, Czuba, Billington, Kersten, & Siegert, 2015). It has been found that the effects of psychotherapy can be improved and treatment failure prevented when therapists get feedback on the therapeutic progress of their patients (e.g., Lutz, Böhnke, & Köck, 2011; Lutz et al., 2015). Furthermore, providing feedback can reduce the number of treatment sessions necessary for the same level of therapeutic success (Lambert et al., 2001) and enhance treatment outcome, especially in patients with a predicted negative response (Lambert, Harmon, Slade, Whipple, & Hawkins, 2005). Hawkins, Lambert, Vermeersch, Slade, and Tuttle (2004) found that feedback on patient's progress to both therapists and patients also lead to greater improvement, compared to dyads without any feedback.

Recently, there is growing research interest in the assessment and feedback of dyadic aspects such as, for example, the accordance between patient and therapist perceptions. Studies investigating the congruence between patient and therapist ratings of patient functioning and the therapeutic relationship have found a substantial temporal accordance (e.g., Atzil-Slonim et al., 2015; Bar-Kalifa et al., 2016). Furthermore, it was found that the congruence between patient and therapist ratings of patient functioning was predictive of better treatment outcome (Bar-Kalifa et al., 2016). So far, studies have measured the congruence between verbally assessed therapeutic process information. However, congruence between patients and therapists can be assessed on many other diverse levels, whereas nonverbal synchrony represents a measure of nonverbal congruence. Increasing the focus on nonverbal aspects (comprising gaze and eye contact, facial expressions, mimic, gestures, postures, body movements and prosody) may be of particular importance as two thirds of human communication takes place on a nonverbal level (Argyle, 1972; Burgoon, Guerrero, & Floyd, 2009; Tonti & Gelo, 2016). These nonverbal aspects had long been neglected in psychotherapy research, however this is currently changing with the embodiment trend shifting away from a cognitivist view (Tickle-Degnen & Gavett, 2003; Tschacher & Pfammatter, 2016). In that sense, in the future nonverbal synchrony may be reported back to therapists, providing a measure of nonverbal aspects of congruence between patients and therapists. This feedback may be used for *personalized predictions* (Lutz, Zimmermann, Müller, Deisenhofer, & Rubel, 2017), for instance, to provide a prognosis on the likelihood of drop-out at the beginning of treatment. When measured and reported back during the course of therapy, nonverbal synchrony may further be used for *personalized adaptations* (Lutz et al., 2017), providing information on nonverbal aspects of collaboration and symptom reduction.

All three studies presented in this dissertation focus on nonverbal synchrony between patients and therapists in outpatient psychotherapy. They are aimed to better understand the concept of nonverbal synchrony, it's associations with patient characteristics (such as diagnosis, movement quantity as a measure of psychomotor retardation/agitation, and symptom reduction) and characteristics of the patient-therapist dyads (therapeutic relationship). In sum, they stress the need for assessing nonverbal synchrony in psychotherapy and its potential for enhancing treatment outcomes in the context of patient-focused research.

The first study (Chapter 5) aims to replicate the findings of the first quantitative naturalistic study on nonverbal synchrony in psychotherapy by Ramseyer and Tschacher (2011). First, the video-based procedures are validated and different confounding variables are tested. Furthermore, associations between the therapeutic relationship, treatment outcome and nonverbal synchrony are investigated.

In the second study (Chapter 6), the focus is on diagnostic differences in nonverbal synchrony. The effect of diagnosis (depression vs. anxiety) on nonverbal synchrony at the beginning and end of therapy is investigated. Furthermore, the effects of patient and therapist movement quantity on nonverbal synchrony are examined.

Study three (Chapter 7) deals with nonverbal synchrony in a sample of patients with social phobia. First, associations between time of assessment (session 3, 8, 20, 30), early response and nonverbal synchrony are examined. Second, interaction effects between nonverbal synchrony and early response on treatment outcome are investigated.

Before the three studies are described in detail (Chapters 5 to 7), a theoretical overview of the previous research literature from which the research questions of the three studies were deduced (Chapter 2) is given. In Chapter 8, implications, limitations and future directions regarding the three studies are discussed.

2 Theoretical Background

2.1 Synchrony Phenomena in Everyday Life and Different Fields of Research

Synchrony is all around us – and in most cases, we are not aware of it. First, to become aware, it is necessary to understand the word *synchrony*. It derives from the ancient Greek words *syn* (engl.: *with/together*) and *chronos* (engl.: *time*) and is related to phenomena that take place at the same time (Pikovsky, Rosenblum, & Kurths, 2003). A commonly known synchrony phenomenon is applause: When many people applaud in a concert hall, an adjustment can be observed so that after some time the whole audience finally applauds in the same rhythm. Another example from everyday life is that we synchronize our steps and walking pace when we take a walk or go jogging with another person. Furthermore, nearly everyone may have experienced the phenomenon that yawning can be contagious. The same works with smiling: It is difficult not to smile when someone smiles at us. This is a phenomenon that many TV series producers have put to use, playing laughter in the background to also make the viewers laugh. Finally, it has repeatedly been observed that the menstrual cycles of women who live closely together synchronize (McClintock, 1971, 1998).

However, synchrony is also known from physics, as Christiaan Huygens was the first to scientifically describe synchrony in his work on pendulum clocks in the 17th century (see Pikovsky, Rosenblum, & Kurths, 2003). When he tested his new patent on ships on the open sea, he recognized that two pendulum clocks, which were both attached to one wooden beam, synchronized their ticking over time. The same phenomenon can be observed in metronomes that stand on the same mobile surface and are started individually, synchronizing their tact over time.

Furthermore, synchrony is present in many areas of biology and can especially be observed in animals living in flocks (Camazine, 2003). Schools of fish and flocks of birds perform coordinated movements without colliding or any hesitation when changing direction

(Strogatz, 2003; Sumpter, 2006). Another example from nature are fireflies that, when sitting on one tree, synchronize their blinking over time, finally making the tree flash periodically (Buck, 1988; Buck & Buck, 1968). Furthermore, crickets synchronize their chirping (Greenfield & Roizen, 1993).

An example that is especially important for psychology is synchrony in neural networks. Neural assemblies of functionally specialized areas in the human brain are synchronously activated when behaviors, thoughts or feelings are present (Haken, 2013; Varela, Lachaux, Rodriguez, & Martinerie, 2001). Those activated neurons oscillate electrically in certain intervals and communication is most effective when they oscillate in synchrony (Fries, 2005; Herrmann, Strüber, Helfrich, & Engel, 2015). Taken together, synchrony exists in many fields of research and everyday life, whereas especially synchrony between persons is to be elucidated more closely in the following.

2.2 Interpersonal Synchrony

When synchrony occurs between interacting persons, giving the impression that behaviors are coordinated or related to each other, it is termed *interpersonal synchrony* (e.g., Bernieri & Rosenthal, 1991; Paxton, 2015). Condon and Ogston (1967) were the first to differentiate between *self-synchrony* (e.g., synchrony between sound elements in the speech and body movements of one person; see Woodall & Burgoon, 1981) and *interactional synchrony* (e.g., synchrony between body movements of two interacting persons; see Ramseyer & Tschacher, 2011), whereas the latter represents the origins of interpersonal synchrony. It comprises imitation (e.g., both persons nod their heads) as well as diverse responses with mutual timing (e.g., one person nods his head, whereas the other person changes his sitting posture; Koole & Tschacher, 2016).

One of the first studies on interpersonal synchrony was the field study by Bernieri (1988), showing that rated movement synchrony was higher in interactions between teachers and their high school students than in randomly selected interactions. In the last 20 years, research interest in interpersonal synchrony has grown. The main reason may be that technical progress has facilitated the measurement of these phenomena via the development of programs with higher resolution, higher user-friendliness, and affordability (Cacioppo, Tassinary, & Berntson, 2007; Hari, Henriksson, Malinen, & Parkkonen, 2015; Koole & Tschacher, 2016).

Recent studies have revealed that interacting persons synchronize their affective (e.g., Feldman, 2003), behavioral (e.g., Repp & Su, 2013), perceptual (e.g., Miles, Nind, & Macrae, 2009), sensomotor (e.g., Sofianidis, Hatzitaki, Grouios, Johannsen, & Wing, 2012), motor (Oullier, De Guzman, Jantzen, Lagarde, & Kelso, 2008; van Ulzen, Lamoth, Daffertshofer, Semin, & Beek, 2008; Varlet, Marin, Lagarde, & Bardy, 2011), physiological (e.g., Marci, Ham, Moran, & Orr, 2007) and neural (e.g., Wheatley, Kang, Parkinson, & Loser, 2012) responses. For instance, it has been found that being involved in joint activities leads to synchrony of neural activations (Cui, Bryant, & Reiss, 2012; Jiang et al., 2015; Lindenberger, Li, Gruber, & Müller, 2009) and synchronous brain stimulation enhances interpersonal synchrony (Novembre, Knoblich, Dunne, & Keller, 2017). It has also been found that persons synchronize their breathing patterns in social interactions (e.g., McFarland, 2001; Yang, 2007), especially near turn-taking and phases of simultaneous speech or laughter (Warner, 1996; McFarland, 2001). Interpersonal synchrony was also observed in regard to language as interacting people synchronize their use of content as well as function words (e.g., Ireland & Pennebaker, 2010; Pickering & Garrod, 2004). Furthermore, people are spontaneously inclined to synchronize their postures and eye gaze, even when they cannot see their partner (Brown-Schmidt & Tanenhaus, 2008; Richardson, Dale, & Kirkham, 2007; Shockley, Santana, & Fowler, 2003).

On a neuronal level, interpersonal synchrony is thought to be facilitated by mirror neurons. Rizzolatti et al. (1988) were the first to show that observing a movement of another person activates those neurons of the observer's brain that are linked to the execution of the observed movements. This neuronal connection between perception and action facilitates motor imitation (Iacoboni, 2009). It has further been found that imitation and observation of emotional facial expressions activates a widely similar network of brain areas, indicating that mirror neurons and their relation to imitation are an important basis to feel empathy (Carr, Iacoboni, Dubeau, Mazziotta, & Lenzi, 2003). Interestingly, imitation does not only enhance empathy, it also seems to have an impact on the relationship between interacting partners. In their experiment on the *chameleon-effect* (perception-behavior link), Chartrand and Bargh (1999) showed that mimicry increases liking between interacting persons. Furthermore, higher levels of interpersonal (movement) synchrony were related to higher observer ratings of being a unit and rapport (Lakens, 2010; Miles, Nind, & Macrae, 2009). In sum, research on neuronal correlates of imitation reveals that mirror neurons enhance motor imitation, feelings of empathy, liking and a sense of belonging – indicating the evolutionary social value of interpersonal synchrony.

Research in developmental psychology has shown that interpersonal synchrony already begins in the early stages of development and takes place between a newborn baby and its caregiver by means of maternal (vocal and tactile) stimulation. These synchronous interactions are related to emotional security, which is considered to down-regulate emotional distress (Feldman, 2007). These early kinds of interpersonal synchrony have shown to be related to the early childhood development of self-regulation with regard to attention, arousal and especially emotional states (Feldman, 2006; Feldman, Greenbaum, & Yirmiya, 1999; Feldman, 2015; Hofer, 1995; Tronick, 1989). Referring to the mutual regulation model of dyadic meaning-making (Tronick & Beeghly, 2011), it is further related to shared meaning-making and general development by alternating periods of dyadic matching (positive affect and engagement), mismatching (negative affect and dysregulation) and reparation. Consequently, interpersonal synchrony is always connected to intrapersonal regulatory abilities and resources (Koole & Tschacher, 2016) and synchrony takes place on the basis of merged perception of the self and the other (Mazzurega, Pavani, Paladino, & Schubert, 2011; Paladino et al., 2010).

In general, imitation and interpersonal synchrony are considered to occur unconsciously and are associated with involvement in an interaction (Paladino, Mazzurega, Pavani, & Schubert, 2010; Pinel, Bernecker, & Rampy, 2015). Furthermore, they are associated with the wish for (Miles, Lumsden, Richardson, & Macrae, 2011) and the presence of a positive relationship between adolescents as well as adults (Bernieri, 1988; Julien, Brault, Chartrand, & Bégin, 2000; Koole & Tschacher, 2016) and between mothers and their own children (Bernieri, Reznick, & Rosenthal, 1988). They are further related to a faster and more accurate identification of emotions (Stel & van Knippenberg, 2008). In addition, synchrony has shown to be positively related to self-disclosure (Vacharkulksemsuk & Fredrickson, 2012) and negatively related to argument (Paxton & Dale, 2013). However, lower levels of imitation are related to the anticipation of social rejection, with high arousal and increased cortisol concentration having been observed (Kouzakova, van Baaren, & van Knippenberg, 2010). In sum, interpersonal synchrony in social interactions plays an important role in the formation of interpersonal relationships (Feldman, 2007; Wiltermuth, & Heath, 2009; Vacharkulksemsuk, & Fredrickson, 2012).

When persons are encouraged to behave interpersonally synchronous, helping behavior and cooperation are promoted (Wiltermuth & Heath, 2009; Kirschner & Tomasello, 2010; Valdesolo & DeSteno, 2011), observable even in 14-month-old infants (Cirelli, Wan, Spinelli, & Trainor, 2017). Furthermore, inviting persons to move synchronously leads to better perceptual sensitivity to movement and further seems to improve performance in a subsequent joint-action task (Valdesolo, Ouyang, & DeSteno, 2010) as well as collaborative problem-solving (Miles, Lumsden, Flannigan, Allsop, & Marie, 2017). Interpersonal synchrony even improves self-esteem (Lumsden, Miles, & Macrae, 2014) and memory performance with regard to information about the interaction partner (Miles, Nind, Henderson, & Macrae, 2010). It also activates brain areas related to social and embodied cognition and self-other expansion (Cacioppo et al., 2014). A recent meta-analysis found that experimentally manipulated interpersonal synchrony (comprising simultaneous actions like lifting arms) was positively associated with prosocial behaviors, positive affect, perceived social bonding and social cognition (Mogan, Fischer, & Bulbulia, 2017). In sum, interpersonal synchrony is considered to facilitate prosocial behavior by increasing compassion, rapport, liking and social affiliation between persons (e.g., Cirelli, Einarson, & Trainor, 2014; Hove & Risen, 2009).

2.3 Nonverbal Synchrony in Psychotherapy Research

Like the aforementioned other fields of research, technical progress has also resulted in a growing number of studies on interpersonal synchrony in psychotherapy research (e.g., Tschacher & Pfammatter, 2016). In recent years, studies were able to show that interpersonal synchrony is also present in psychotherapy as patients and therapists tend to synchronize their vocal pitch and their levels of skin conductance (e.g., Marci et al., 2007; Reich, Berman, Dale, & Levitt, 2014). It was found that concordance in skin conductance was associated with ratings of therapist empathy (Marci et al., 2007), whereas vocal pitch synchrony was positively related to therapist empathy in one study (Imel et al., 2014), and negatively associated with therapist empathy and treatment outcome in another study (Reich et al., 2014). A further study investigated associations between linguistic style synchrony (accordance in the use of function words between patient and therapist) in psychotherapy and ratings of therapist characteristics. It was found that higher levels of synchrony were related to higher ratings of therapist empathy (Lord, Sheng, Imel, Baer, & Atkins, 2015).

However, the majority of recent studies on interpersonal synchrony in psychotherapy have focused on *nonverbal synchrony*, which is defined as the nonverbal coordination between interacting persons (going back to Condon & Ogston, 1966). Nonverbal synchrony can be divided into aspects measured qualitatively or quantitatively. Examples for qualitatively measured nonverbal synchrony are the matching of nonverbal emotional expressions and body postures, as well as the imitation of mannerisms and facial expressions (e.g., Charny, 1966; Geerts, van Os, Ormel, & Bouhuys, 2006; LaFrance, 1979; Meltzoff & Moore, 1977, 1983). This operationalization primarily used human ratings to assess synchrony and was applied for a long time. However, it is related to certain methodological problems such as observer biases, a high error rate and being time-consuming (e.g., Baesler & Burgoon, 1987; Bernieri, 1988).

Recent technical progress made it possible to measure nonverbal synchrony quantitatively and automatically by methods using videos of interactions (rather assessing the quantity of movements represented by change in pixels; e.g., Altmann, 2011, 2013; Katsumata, Ogawa, & Komori, 2009; Thielemann et al., 2017). This operationalization of nonverbal synchrony, which was also applied in the studies included in this dissertation, has certain features, expanding the definition of Condon and Ogston (1966): It is measured automatically and objectively by video analysis algorithms assessing pixel changes (e.g. Motion Energy Analysis, MEA), conceptualized as a dynamic quality (movements are assessed, not specific static gestures or postures; Bernieri & Rosenthal, 1991) and comprises simultaneous as well as time-lagged movements. With this method it has become possible to automatically analyze videos of therapy sessions and to objectively calculate nonverbal synchrony in patient-therapist dyads.

Ramseyer and Tschacher (2010) first applied MEA to a psychotherapy dataset revealing that the measurement of nonverbal synchrony goes significantly beyond random coincidence. Applying the described definition, only few empirical studies of nonverbal synchrony in psychotherapy have been conducted so far, and are described in detail in the following.

A first single case analysis on a patient-therapist dyad in outpatient psychotherapy (N=21 sessions) found that body-synchrony was positively correlated with patient and therapist ratings of the therapeutic relationship (Ramseyer & Tschacher, 2008).

Ramseyer and Tschacher (2011) investigated nonverbal synchrony in a naturalistic sample including N=70 patients (only same-sex patient-therapist dyads) in outpatient psychotherapy and analyzed N=104 videos of therapy sessions (n=47 from the initial phase of therapy, n=57 from the final phase of therapy). It was found that nonverbal synchrony was higher than synchrony in artificially produced interactions (pseudosynchrony) and positively associated with the patient-rated therapeutic relationship and self-efficacy. Furthermore, it was positively related to symptom reduction and therapy outcome.

Another study focused on nonverbal synchrony concerning head and upper-body movements. The authors analyzed N=70 therapy videos (n=33 from the initial phase of therapy, n=37 from the end) of N=70 patients (only same-sex dyads) in outpatient psychotherapy. It was found that head-synchrony was positively related to global therapy outcome whereas upper-body-synchrony was positively related to session outcome (conceptualized as patient-rated alliance and self-efficacy), but not vice versa (Ramseyer & Tschacher, 2014).

Furthermore, Ramseyer and Tschacher (2016) examined nonverbal synchrony in a single-case analysis and investigated hand movements between a patient and his therapist during the course of an outpatient psychotherapy (N=27 sessions). Hand-synchrony was positively associated with patient ratings of the therapeutic relationship.

In addition, several studies have investigated characteristics of schizophrenic patients and nonverbal synchrony. Kupper, Ramseyer, Hoffmann and Tschacher (2015) investigated nonverbal synchrony in N=378 videotaped role-play scenes with N=27 stabilized paranoid schizophrenic outpatients. Head-synchrony was found to be negatively related to symptoms and positively related to social functioning, social competence and self-evaluation of competence (even when controlling for the amount of patient movement). Negative symptoms were further associated with reduced head and body movements, movement speed as well as with lower imitation of the other person's movements. Positive symptoms were related to lower imitation of the outpatient's movements by the interaction partner (Kupper, Ramseyer, Hoffmann, Kalbermatten, & Tschacher, 2010). Kupper, Ramseyer, Drozynski, Hoffmann, and Tschacher (2015) replicated the above-mentioned findings (N=17 social role-play interactions with patients diagnosed with schizophrenia) and revealed associations between negative symptoms, reduced movements and reduced movement speed. Furthermore, it was found that reduced movement speed was related to cognitive symptoms. Galbusera, Finn and Fuchs (2016) also investigated nonverbal synchrony in pre- and post-treatment (manualized body-oriented psychotherapy) interviews with N=16 patients with schizophrenia and found a negative relation between nonverbal synchrony and negative symptoms.

Studies on the effects of experimental manipulation of nonverbal synchrony in psychotherapy are rare, mainly due to ethical concerns. Previous studies have investigated simulated psychotherapy sessions whereas the "therapists" were instructed to move more or less synchronously with their "patients". Trout and Rosenfeld (1980) found associations between rapport (rated by independent observers) and congruent forward-leaning and limbs postures in simulated client-therapist interactions. Maurer and Tindall (1983) found that clients rated counselors as more empathic when they mirror imaged their arm and leg positions (in contrast to counselors who did not mirror image). Further studies compared nonverbal synchrony in positively and negatively evaluated role-play scenes of counselling situations. Sharpley, Halat, Rabinowicz, Weiland and Stafford (2001) analyzed interviews of post-graduate students in counselling psychology with one standardized client and found relations between client-rated rapport and a higher amount of postural mirroring of the torso as well as higher flexibility in counselors body positions. Nagaoka and Komori (2008) also found a higher level of nonverbal synchrony in positively evaluated role-plays of psychotherapeutic counseling sessions, compared to negatively evaluated ones.

In sum, the mentioned studies reveal that nonverbal synchrony is linked to the therapeutic relationship, although concrete relating mechanisms remain unknown. One explanation may be that nonverbal synchrony between patients and therapists enhances empathic understanding (Levenson & Ruef, 1997), improving in turn the therapeutic relationship (Bavelas, Black, Lemery, Mullett, & Eisenberg, 1987). Another explanation refers to nonverbal synchrony having a communicative function, which leads to a common attentional orientation and conception of a situation (e.g., Bavelas et al., 1987), consequently increases attachment (Scheflen, 1964; Wallbott, 1996). Another theory goes back to Tickle-Degnen and Rosenthal (1990) who postulated rapport – including attentiveness, positivity-negativity and coordination – to be one of the prerequisites for the development of the therapeutic relationship, whereas nonverbal synchrony may be one facet of coordination. Finally, the interpersonal synchrony (In-Sync) model of psychotherapy by Koole and Tschacher (2016) combines previous findings and provides a theory for understanding the relations between nonverbal synchrony, aspects of the therapeutic relationship and therapy outcome. It postulates that nonverbal synchrony establishes inter-brain coupling between patient and therapist, providing access to each other's internal states (common understanding, emotional sharing). In the further course of therapy, the patient's emotion-regulatory capacities are improved by those interpersonal exchanges, finally effecting therapeutic outcome.

Taken together, nonverbal synchrony has shown to be associated with the therapeutic relationship, self-efficacy, treatment outcome and diagnosis. However, there is a strong need for replication in naturalistic samples and further studies of diagnostic effects on nonverbal synchrony and change patterns during therapeutic processes. This new field of research has the potential to provide new and important impulses for patient-focused psychotherapy research. This is especially important as nonverbal aspects of the patient-therapist dyad have been widely ignored in psychotherapy research thus far (Tschacher & Pfammatter, 2016), although it has been known for a long time, that the therapist's nonverbal behavior has an important impact on the quality of the therapeutic relationship (e.g., Philippot, Feldman, & Coats, 2003). However, the research focus is shifting towards nonverbal aspects in the context of growing research interest in embodiment in recent years (e.g., Tschacher, Giersch, & Friston, 2017).

3 Research Questions

The first study investigates associations between nonverbal synchrony, the therapeutic relationship, and treatment outcome. It aims to replicate Ramseyer and Tschacher's (2011) findings in a naturalistic sample with same- and opposite-sex dyads. The second study compares nonverbal synchrony between dyads with depressive and anxious patients. Therefore, nonverbal synchrony is measured at the beginning and the end of each therapy and analyses control for movement quantity (to adjust for psychomotor retardation/agitation). The objective of the third study is to investigate associations between nonverbal synchrony, early response and treatment outcome. Analyses are based on a sample of patients with social phobia and nonverbal synchrony is measured at four times of assessment during the course of therapy. All three samples were derived from the University of Trier's outpatient clinic database.

3.1 Study 1:

1. Is Motion Energy Analysis (MEA) a valid video-based approach to measure nonverbal synchrony?
2. Is nonverbal synchrony associated with the therapeutic relationship in a sample with same- and opposite-sex dyads?
3. Is nonverbal synchrony related to therapy outcome and drop-out?

3.2 Study 2:

1. Do depressive patients move less than anxious patients at the beginning, but not at the end of therapy?
2. Is nonverbal synchrony lower in dyads with depressive patients than in dyads with anxious patients at the beginning, but not at the end of therapy (even when controlling for movement quantity as a measure of psychomotor retardation/agitation)?

3.3 Study 3:

1. Do dyads (with patients suffering from social phobia) with early responders show higher levels of nonverbal synchrony than dyads with initial non-responders - at the beginning as well as during the further course of therapy?
2. Does nonverbal synchrony in patients with social phobia decrease during the course of therapy, as research on anxiety patients has revealed so far?
3. Is there an interaction between nonverbal synchrony and early response with regard to treatment outcome?

4 Methodological Aspects

All three studies share a common procedure for video analysis and calculating nonverbal synchrony as well as for dealing with hierarchical data (multilevel modelling). Therefore, the following section briefly describes both methods in general and with an emphasis on the specific methods applied in the three summarized studies.

4.1 Motion Energy Analysis and Calculation of Nonverbal Synchrony

For a long time, the only possibility for assessing nonverbal behavior and synchrony was to use human ratings. Raters evaluated the extent of shared attention focus, engagement of reciprocal and responsive interaction or the match of postures, mannerisms and facial expressions (e.g., Chartrand & Bargh, 1999; Lindsey, Mize, & Pettit, 1997). Nonverbal synchrony was assessed by ratings of the strength of accordance between those behaviors of the interaction partners. Prominent examples for coding systems of nonverbal behaviors are the Facial Action Coding System (Ekman, Friesen, & Hager, 2002) or the Berner System to assess body postures (Frey, Hirsbrunner, & Jorns, 1982). However, this approach was time-consuming and prone to error (Baesler & Burgoon, 1987; Bernieri, 1988). In recent years and with the aid of technical progress, it has become possible to automatically and objectively measure nonverbal behaviors and consequently calculate nonverbal synchrony. Today, nonverbal behavior can be measured fully automatically and with high time resolution (e.g. 25 frames per second) using either motion capture devices or video-based algorithms (Delaherche et al., 2012).

A current video-based method analyzing movements of interacting persons is *Motion Energy Analysis* (MEA; Altmann, 2013; Grammer, Honda, Juette, & Schmitt, 1999; Ramseyer & Tschacher, 2011; Watanabe, 1983). MEA measures pixel changes and generates time series representing the amount of movement of each person. To ensure the measurement of movements of interest, so-called *regions of interest* (ROI) can be defined, representing one area for each person where movements take place and are to be measured. Time series are generated with regard to these ROIs, which can then be used to calculate nonverbal synchrony. According to Fogel (1993), the process of co-regulation between two interacting individuals is a dynamic process, changing during the interaction. Therefore, nonverbal synchrony in general is operationalized as the degree of accordance between both time series. Various methods of calculation exist (for an overview, see Delaherche et al., 2012). The most common methods are correlative and regressive time series analyses, which are computed for segments or the entire time series to evaluate accordance. Those methods can be applied using time-lags (with the underlying assumption that synchrony can also appear time delayed in terms of "echoing") and without using time-lags (with regard to the assumption that synchrony only represents simultaneous movements in terms of "matching").

In all three studies, videos of therapy sessions originating from the University of Trier's outpatient clinic database were used for analysis. Selection of patients was conducted in accordance with each study's diagnostic inclusion criteria, whereas patients with acute psychosis and substance dependency were excluded because of assumed severe effects on their ability to nonverbally synchronize (e.g., Ramseyer & Tschacher, 2011; Kupper et al., 2015). Therapy videos were analyzed with MEA, whereas studies 1 and 2 used MEA as a software implemented with a graphical user interface (Ramseyer, 2016) and study 3 used MEA implemented in Matlab (Altmann, 2010, 2013). Both programs were used to analyze videos cut to a 15 min length and converted into .mov format before analysis. In studies 1 and 2, videos were analyzed with a framerate of 10 frames/sec, in study 3 the framerate was set to 25 frames/sec. In all three studies, the upper body beginning at the seat of the chair was defined as the ROI of each person as legs were often covered by the table. As a next step, MEA was run. The output of MEA was in all cases a file including two time-series: One representing patient movement, the other representing therapist movement. Values represented pixel changes, whereas the higher the value, the bigger the movement. Afterwards, these time-series were used to compute values of nonverbal synchrony.

In all three studies, some pre-processing steps were performed before nonverbal synchrony was calculated. Thus, time series were smoothed (whereas in study 3, video image errors were detected and deleted), a threshold for minimal movement was applied and different ROI sizes were accounted for (in studies 1 and 2 by z-transformation, in study 3 by dividing all values by the number of pixels in each ROI).

Afterwards, nonverbal synchrony was computed by cross-correlating each pair of time-series in segments (of 1 minute duration in studies 1 and 2 and of 5 seconds duration in study 3) and time lags of up to five seconds. In studies 1 and 2, correlation coefficients were aggregated to a global value representing the average strength of nonverbal synchrony in each therapy video. In study 3, correlation coefficients were tested against zero (non-significant correlations were set to zero) and a peak-picking algorithm was applied to identify meaningful synchrony. The global value of nonverbal synchrony was calculated by dividing the time with significant synchrony by the total duration of the sequence (and then multiplying it by 100), representing the percentage of the frequency of synchronous movements in each video. In all three studies, measures of nonverbal synchrony were adjusted for spurious correlations. While in studies 1 and 2 a value of "pseudosynchrony" was calculated and deducted from each value of nonverbal synchrony, in study 3 the applied significance test and peak-picking algorithm were performed to account for randomly occurring synchrony.

4.2 Multilevel Modelling

In all three studies, multilevel modelling was employed, which is recommended as the method of choice for hierarchical data (Hox, 2010; Lutz, Leon, Martinovich, Lyons, & Stiles, 2007). In the presented studies, patients (level 1) were nested within therapists (level

2), therefore two-level models were calculated. It has been recognized that therapists play a central role within the process of psychotherapy (for a review, see Baldwin & Imel, 2013) whereas Ricks (1974) was the first to report empirical evidence for differences between therapists. In multilevel modelling, therapist effects correspond to the intraclass correlation coefficient (ICC) (Raudenbush & Bryk, 2002; Schiefele et al., 2016). Random coefficient models are applied if there is no theoretical assumption preventing it. There are several indices to assess the fit of each model and compare models, whereas Akaike's information criterion (AIC) and Schwarz's Bayesian criterion (BIC) are the most commonly used. The specific models referring to the analyses performed in the three studies are described precisely in each of the study's methods sections (see Chapters 5.2, 6.2, 7.2).

5 Study I: Nonverbal Synchrony: A New Approach to Better Understand Psychotherapeutic Processes and Drop-Out

Paulick, J., Deisenhofer, A.-K., Ramseyer, F., Tschacher, W., Boyle, K., Rubel, J., & Lutz, W. (2017). Nonverbal Synchrony: A New Approach to Better Understand Psychotherapeutic Processes and Drop-Out. *Journal of Psychotherapy Integration*. Advance online publication. doi:10.1037/int0000099

5.1 Abstract

Background: Video-based measurement methods are new to psychotherapy research and provide new opportunities to investigate mechanisms of psychotherapeutic change related to nonverbal synchrony (movement coordination between patient and therapist). In this study, we validated the applied video-based procedures and evaluated nonverbal synchrony in association with the therapeutic relationship, therapy outcome and drop-out.

Method: The naturalistic analysis sample consisted of 143 patients (136 videotaped sessions), who were treated with integrative cognitive behavioral therapy at an outpatient clinic in southwest Germany. The videos were analyzed using Motion Energy Analysis (MEA), which provided a value for nonverbal synchrony. Patients routinely completed questionnaires assessing the therapeutic relationship and treatment success. We tested various confounding variables using multilevel modelling and investigated nonverbal synchrony in relation to measures of the therapeutic relationship. Furthermore, we compared different types of outcomes with regard to nonverbal synchrony by means of multilevel modeling.

Results: The video-based procedures were shown to be highly valid. We found a link between the amount of nonverbal synchrony and therapeutic success: Patients with non-improvement and consensual termination showed the highest level, improved patients a medium level, and non-improved patients with drop-out the lowest level of synchrony at the beginning of therapy, even when controlling for the therapeutic relationship.

Conclusions: The study applied and evaluated a novel video-based approach in psychotherapy research and related it to common factors and the therapeutic process. Limitations of the automatic measurement methods and opportunities for the future routine prediction of drop-out are discussed.

Keywords: nonverbal synchrony, therapeutic relationship, congruence, outcome, drop-out

5.2 Introduction

Evidence suggests that successful therapy does not only depend on specific therapeutic techniques, but also on principles of change that are present across psychotherapeutic modalities (Castonguay, Eubanks, Goldfried, Muran, & Lutz, 2015; Goldfried, Pachankis, & Bell, 2005; Castonguay & Goldfried, 1994). The therapeutic relationship is the mechanism of change, which has received the most empirical attention, as is reflected by numerous meta-analyses (e.g. Horvath & Symonds, 1991; Martin, Garske, & Davis, 2000; Sharf, Primavera, & Diener, 2010; Flückiger, Del Re, Wampold, Symonds, & Horvath, 2012). Moreover, Horvath, Del Re, Flückiger and Symonds (2011) have identified more than 200 research papers that focus on the therapeutic relationship. There is strong empirical support for the assumption that the quality of the therapeutic relationship is predictive of therapeutic outcome across different types of therapy (Flückiger, Del Re, Wampold, Symonds, & Horvath, 2012; Norcross & Wampold, 2011; Orlinsky, Rønnestad, & Willutzki, 2004).

A relationship variable that has received less attention from empirical research is congruence (Kolden, Klein, Wang, & Austin, 2011). This may be due to varying definitions and measures that exist in the literature. On the one hand, within the client-centered approach, congruence refers to a therapist’s relational quality of mindful genuineness in the therapeutic relationship (Rogers, 1957). This includes present personal awareness, genuineness or authenticity and the capacity to communicate his/her experiences to the client, which requires careful self-reflection and considered self-judgment (Kolden, Klein, Wang, & Austin, 2011). If the patient does not perceive the therapist as genuine, neither empathy nor regard can be conveyed (Kolden, Klein, Wang, & Austin, 2011). Congruence, in terms of the therapist's relational quality of genuineness, has been highly valued throughout the history of psychotherapy (e.g. Meltzoff & Kornreich, 1970; Luborsky, Chandler, Auerbach, Cohen, & Bachrach, 1971; Lambert, DeJulio, & Stein, 1978; Orlinsky, Grawe, & Parks, 1994).

In psychology in general, congruence is defined and measured more specifically, referring to the match of concrete verbal and nonverbal behavior between two interaction partners (Shapiro, 1965). Research in developmental and social psychology has revealed a positive association between verbal-nonverbal congruence (the match of one person's verbal and the nonverbal statements), outcome in counseling situations (Hill, Siegelman, Gronsky, Sturniolo, & Fretz, 1981) and positive interactions in non-delinquent families (Lessin & Jacob, 1979). Other studies have measured the accordance of or synchrony between the nonverbal behaviors of two interacting persons. Condon and Ogston (1966) defined movement coordination between interacting partners as "nonverbal synchrony". In developmental and social psychology, previous studies of nonverbal synchrony have been able to show a positive association with children's social competence (Lindsey, Mize, & Pettit, 1997) and fondness between interaction partners (Chartrand & Bargh, 1999). Tucker & Anders (1998) found an association between a secure attachment style and nonverbal synchrony during an interaction with a dating partner.

With technical progress, it has recently become possible to automatically analyze videos of dyads. Video analysis provides an alternative to the previous use of ratings to measure nonverbal behavior and a solution to some of the associated problems such as its time-consuming nature and issues with low interrater-reliability (Baesler & Burgoon, 1987; Bernieri, 1988). Bernieri and Rosenthal (1991) conceptualized nonverbal synchrony, measured by automatic video analysis, as a dynamic assessment of body movements and their reference to one another, in contrast to previous research based on observer ratings of specific gestures and postures.

Early studies that applied the automatic measurement of nonverbal synchrony primarily investigated mother-neonate-interactions (Watanabe, 1983), finding higher nonverbal synchrony in interactions between mothers and their own children than in interactions with unfamiliar children (Bernieri, Reznick, & Rosenthal, 1988). Recent studies in social psychology have revealed a positive relationship between the level of (automatically measured) nonverbal synchrony in students and their interest in the lesson (Katsumata, Ogawa, & Komori, 2009). In courtship communication, female movement synchrony was related to interest in the dating partner (Grammer, Honda, Juette, & Schmitt, 1999). Further studies have found nonverbal synchrony to be negatively related to conflicts between children (Altmann, 2011, 2013) and positively related to positive affect in adults (Tschacher, Rees, & Ramseyer, 2014). Overall, research in developmental and social psychology has shown that nonverbal synchrony in dyads, no matter whether rated or automatically measured, is associated with higher relationship quality, resonance, and better development. These findings can be classified within models understanding constructs like synchrony as mechanisms of dyadic interactions, such as the mutual regulation model of dyadic meaning-making (Tronick & Beeghly, 2011). It states that interactions between infants and caregivers are characterized by alternating periods of dyadic matching (positive affect and engagement), mismatching (negative affect and dysregulation) and reparation, which has implications for shared meaning-making and general development.

While, in other research fields, the investigation of nonverbal behavior has long been established as a part of research practice, psychotherapy research has been more focused on verbal than nonverbal behavior. The vast majority of research on common factors, such as the formation of the therapeutic relationship, has focused on verbal aspects (Tickle-Degnen & Gavett, 2003). The few studies on nonverbal behavior in psychotherapy have either focused on the nonverbal behavior of the patient or that of the therapist, showing, for example, that the therapist's nonverbal behavior plays a decisive role in the development of the therapeutic relationship (Hall, Harrigan, & Rosenthal, 1995). Psychotherapy research, however, long ignored nonverbal interaction in patient-therapist dyads, surely as a result of insufficiently objective and economic measurement methods. However, it may just be the interaction, namely the nonverbal synchrony in dyads, which is especially important, as we have seen in other research fields.

As is the case in social and developmental psychology, psychotherapy research has also profited from current technical progress. As a result, research on nonverbal synchrony in psychotherapy has begun to increase with first findings pointing to an association between nonverbal synchrony, therapeutic outcome and common factors such as the quality of the therapeutic relationship and patient self-efficacy (Koole & Tschacher, 2016; Tschacher & Pfammatter, 2016). To date however, few researchers have focused on this topic and the existing literature concerning the therapeutic relationship is heterogeneous. Some authors have found a positive association between nonverbal synchrony and the quality of the therapeutic relationship, but only when rated by the patient. When the therapist rated the therapeutic relationship however, no association with nonverbal synchrony could be found (Ramseyer & Tschacher, 2011). Other authors even found a negative relationship between prosodic synchrony (vocal pitch of patient and therapist), herein considered nonverbal synchrony, and ratings of the therapeutic relationship (Reich, Berman, Dale, & Levitt, 2014). While the association with the therapeutic relationship has been shown to be heterogeneous, the positive relationship with therapeutic outcome has been confirmed repeatedly (Ramseyer

& Tschacher, 2011; Kupper, Ramseyer, Hoffmann, & Tschacher, 2015; Reich, Berman, Dale, & Levitt, 2014; Galbusera, Finn, & Fuchs, 2016).

As the automatic analysis of therapy videos for the assessment of nonverbal synchrony remains a very new approach in psychotherapy research, therefore the first aim of this paper was the application and validation of a video-based approach to measure nonverbal synchrony and exclude measurement errors and artefacts within a naturalistic dataset.

As automatically rated video data and survey data have rarely been combined in the field of psychotherapy research, the second aim of the study was to investigate associations between nonverbal synchrony, the therapeutic relationship (rated by the patient and therapist), therapy outcome and drop-out and possibly replicate previous findings. Based on the literature summarized above, we consider nonverbal synchrony an operationalization of the general psychological construct congruence (i.e. the match between (nonverbal) behaviors of two interaction partners; Shapiro, 1965). In the psychotherapeutic context, such an accordance of nonverbal behavior between patient and therapist may be considered a nonverbal aspect of Rogers' (1957) therapeutic relationship quality of congruence, as it is possible that this accordance is part of engaging in genuine contact with the patient.

5.3 Methods

Participants and Treatment

The analyses were based on a sample comprised of 143 patients treated by 27 therapists between 2007 and 2013 at an outpatient clinic in southwest Germany. Patients included in the analysis received at least six sessions of individual treatment with a mean treatment length of 38.4 sessions (range= 6-82). 136 videotaped sessions (mean: session 5, range= session 3-12) from the beginning of therapy (defined as the first third of attended sessions; videos were selected according to suitability for video analysis, see below) were used for the current analyses. Patients were over 16 years of age (M= 36.5, range= 16–68) and the majority was female (54.5%). Sessions were selected by checking suitability for video analysis (see below). Therapists (66.7% female, mean age: 31.1 years) treated between 1 and 14 patients (mean= 5.3 patients). All therapists in this project participated in a 3-year (full-time) or 5-year (part-time) postgraduate training program with a cognitive-behavioral therapy (CBT) focus and had received at least one year of training before beginning to see patients. They were supervised by a senior therapist every 4th session and were supported by a feedback system monitoring patient outcomes on a session-by-session basis. The CBT program consisted of psycho-education on the respective disorder, relaxation training, cognitive restructuring and in sensu as well as in vivo situational exposure for patients with behavioral avoidance. Furthermore, therapists were trained in an integrative CBT approach including interpersonal and emotion-focused elements (Castonguay, Eubanks, Goldfried, Muran, & Lutz, 2015; Grawe, 2004; Lutz, Schiefele, Wucherpfennig, & Stulz, 2016). All therapists were familiar with various disorder-specific CBT manuals, but individually adapted their approach depending on patients' characteristics. Psychometric feedback was provided to therapists after each session. Research data was routinely collected via a range of instruments and therapy sessions were consistently videotaped. Patients were diagnosed based on the Structured Clinical Interview for Axis I DSM-IV Disorders (SKID-I; Wittchen, Wunderlich, Gruschwitz, & Zaudig, 1997). For the diagnosis of personality disorders, the International Diagnostic Checklist for Personality Disorders (IDCL-P; Bronisch, Hiller, Mombour, & Zaudig, 1996) was applied. Both diagnostic instruments were conducted by intensively trained independent clinicians before actual therapy began. The interviews were videotaped and subsequently interviews and diagnoses were discussed in expert consensus teams comprised of four senior clinicians. Final diagnoses were determined by consensual agreement of at least 75% of the team members. For diagnostic distribution see Table 1.

We excluded all patients diagnosed with psychosis or substance dependency from the original sample as we assumed that both disorders have severe effects on nonverbal behavior, which could distort our data. Furthermore, after these exclusions our sample was diagnostically comparable to that of Ramseyer and Tschacher's (2011) study, which we attempted to replicate in our study. Table 1 provides an overview of sample characteristics.

Furthermore, videos were prescreened and excluded if the following criteria were fulfilled: a) patient transfer to a different therapist during the course of therapy, b) low quality video and c) patient or therapist left their seating place during the first 15 minutes of the relevant video sequence (because they moved out of the camera's focus and their movements could no longer be analyzed).

We used the first 15 minutes of each therapy session for further analyses, because later the interaction was frequently interrupted by the use of white boards or roleplays (where patient and therapist left their seating places). The correlation between nonverbal synchrony during the first 15 minutes and the entire 50 minutes of the therapy session was significant at the specified .05 level, r(124)=.80, $p<.001$.

Measurement of Nonverbal Synchrony via Motion Energy Analysis (MEA)

All therapy sessions were recorded using two cameras joined into a split-screen image, which was the basis of the further measurement of nonverbal synchrony. Video quality was ensured by means of a static camera position, stable light conditions and digitized film material. Nonverbal synchrony was measured via an objective and automated video-analysis algorithm called Motion Energy Analysis (MEA, Ramseyer & Tschacher, 2011; Ramseyer, 2016). MEA measures the amount of movement by splitting a video into many images (we used 10 frames per second) and depicting these images using grey-scale pixels. When a person moves, a certain number of pixels changes from black to white or vice versa (a small movement causes a small number of pixels to change, a large movement causes many pixels to change color). MEA computes the differences between these grey-scale pixels for all consecutive frames for each interacting person (defined as motion energy by Grammer et al., 1999). To automatically exclude minimal light changes or video noise from the analyses, a threshold for movement detection can be set, so that only values above this threshold are taken into account. In line with the study that originally employed MEA, we defined the upper body beginning at the seat of the chair as a specific region of interest (ROI), as patients' and therapists' legs were often covered by the table or one person's feet were visible on the others person's split screen.

The raw data output from MEA is a .txt file containing a time-series of pixel changes for each ROI, which must be pre-processed before synchrony can be quantified. First, to reduce fluctuations due to signal distortion), the time-series were smoothed with a moving average of 0.4 seconds. Afterwards, the data were z-transformed in order to account for differing sizes of the ROIs (e.g. in a small therapy room, the cameras were closer to one person than to the other, which made one person appear larger in the video, causing that person's ROI to be larger). Subsequently, a threshold for minimal movement was calculated (with an algorithm written using the statics software R) for each person's ROI (for details, see Grammer et al., 1999).

Quantification of Synchrony. Next, the corrected motion energy time-series (as described above) were processed in order to compute the level of synchrony. For this purpose, they were cross-correlated within window segments of a one-minute duration (for each window, cross-correlations were computed for positive and negative time lags up to five seconds in steps of 0.1 seconds). Subsequently, these cross-correlations were standardized with Fisher's z and their absolute values aggregated to a global value of nonverbal synchrony for each 15-minute video sequence. Finally, correlation coefficients represented the level of nonverbal synchrony (M=0.15, SD=0.05). Figure 1 shows two examples of a high and a low level of nonverbal synchrony.

Control for Spurious Correlations: Pseudosynchrony. A possibility to control for coincidental synchrony is to generate pseudointeractions, meaning interactions that never actually took place. We generated such pseudointeractions on short time-scales by using automated surrogate testing algorithms according to the procedure described by Ramseyer & Tschacher (2010). For this purpose, we re-combined one-minute segments of the time-series of patient and therapist and created surrogate datasets (n=100 from each genuine dataset). In doing so we created artificial time-series with movement energy that never took place. We calculated the nonverbal synchrony of these shuffled datasets identically to the synchrony of the original datasets described above. We then compared these two mean values for each video in the sample. Pseudosynchrony is later used to calculate an adjusted value of nonverbal synchrony, which is corrected for the session's specific spurious correlations (see Data Analytic Strategy).

Instruments

Penn Helping Alliance Questionnaire (HAQ). The HAQ (Alexander & Luborsky, 1986; German translation by Bassler, Potratz, & Krauthauser, 1995) is an 11-item self-report questionnaire, which assesses the therapeutic relationship and process and has a 6-point Likert scale ranging from 1 ("strongly disagree") to 6 ("strongly agree"). Internal consistency is high in our sample (HAQs_pre: α=.81; HAQs_post: α=.96; HAQf_pre: α=.87; HAQf_post: α=.91) and comparable to that of the German version of the HAQ reported in the literature (α=.89; Bassler, Potratz, & Krauthauser, 1995). The therapeutic relationship was assessed from the patient's and therapist's perspective after the third and last session of therapy.

Outcome Questionnaire (OQ-30). The OQ-30 (Lambert, Hatfield, Vermeersch, & Burlingame, 2001) is a short form of the OQ-45 (Lambert et al., 2004) and measures symptom distress. It has a 5-point Likert scale ranging from 0 ("never") to 4 ("almost always”). Internal consistency is very high (α=.93) and the retest value satisfactory (r_{tt}=.84; Lambert et al., 2001). Calculations in this study are based on the mean score.

Brief Symptom Inventory (BSI). Symptom severity was measured using the BSI (Franke, 2000; German translation of Derogatis, 1975), which was applied as a second outcome instrument. This 53-item self-report inventory is the brief version of the Symptom Check-List-90-Revised (SCL-90-R; Derogatis, 1975) and assesses psychological and physical symptoms within the last week. Items are based on a 5-point Likert scale ranging from 0 (“not at all”) to 4 (“extremely”). The psychometric properties of this index can be regarded as excellent: Franke (2000) reports an internal consistency of α=.92 and a retest-reliability of r_{tt}=.90. In this study, the Global Severity Index (GSI) was used and computed by averaging all BSI items at pre- and post-treatment.

Inventory of Interpersonal Problems (IIP-12). Interpersonal distress was assessed using the IIP-12 (Lutz, Tholen, Schürch, & Berking, 2006), which is a 12-item short form of the IIP-D (Horowitz, Strauß, & Kordy, 2000) and is implemented as a third measure of therapeutic outcome. The instrument comprises four subscales based on the circumplex model of interpersonal behavior and items are scored on a 5-point Likert scale ranging from 0 (“not”) to 4 (“very”). It is highly correlated with the IIP-D (r=.89) and has good reliability scores (r_{tt}=.76, α=.74; Lutz et al., 2006).

Data Analytic Strategy

First, we employed a dependent t-test to compare synchrony and pseudosynchrony to validate the applied video-based measurement method. Effect sizes were calculated using Cohen’s d. For all further analyses, we decided against using the raw score of nonverbal synchrony (NS) applied thus far, but rather chose to use an adjusted value of nonverbal synchrony (cNS), which is corrected for session specific pseudosynchrony. As such: corrected nonverbal synchrony (cNS) = (global value of NS - pseudosynchrony)/ SDpseudosynchrony. This procedure reduces artefacts due to incidental effects. Further, as patients were nested within therapists, a multilevel model was employed, which is recommended as the method of choice for hierarchical data (Hox, 2010; Lutz, Leon, Martinovich, Lyons, & Stiles, 2007).

Second, to test for confounding variables, we included dyad types (same- vs. opposite-sex dyads) and measures of patient symptom severity at intake (OQ, BSI, IIP) as predictors and cNS as the criterion in our random-intercept models.

For the analysis of the association between cNS and the therapeutic relationship, we calculated two-level models with patients on level 1 and therapists on level 2 (Schiefele et al., 2016), using the therapeutic relationship measures (rated by patient and therapist) from the beginning (after the third session) and end of treatment (after the last session) as predictors and cNS from the beginning of treatment as the criterion in our random-intercept models.

Level 1: $therapeutic\_relationship_{ij}=\pi_{0}j + \pi_{1j} * synchrony_{ij} + e_{ij}$

Level 2: $\pi_{0j}=\beta_{00} + r_{0j}$

$\pi_{1j} = \beta_{10}$

For the analysis of the association between cNS and therapy outcome, we first performed multilevel modelling with cNS as the predictor and change scores (difference between the beginning and the conclusion of the full course of treatment) of each of the three outcome measures (OQ-30, BSI and IIP-12) as criteria. Secondly, we investigated the relationship between cNS and drop-out by performing multilevel modelling with cNS as the predictor and drop-out as the dummy-coded criterion (0 dyads with patients who dropped out of therapy early, 1 dyads with patients who ended therapy consensually, independent of symptom reduction). Thirdly, in order to investigate drop-out as well as symptom reduction at post-treatment (improvement, no change and deterioration), patients were classified into three groups based on the concept of reliable change (e.g. Jacobson and Truax, 1991; Lutz, Stulz, Martinovich, Leon, & Saunders, 2009). To classify patients according to this concept, the reliable change index (RCI) of each instrument is required. Reliable change is achieved when the pre-post difference exceeds the measurement error of the instrument. For this classification we used the OQ-30's RCI=.31 (SD=.42, α=.93; Lambert et al., 2001), the BSI's RCI=.56 (SD=.72, α=.92; Franke, 2000) and the IIP-12's RCI=.88 (SD=.62, α=.74; Lutz et al., 2006).[1] Subsequently, patients were classified as improved if the RCI condition was fulfilled (meaning that the difference between the beginning and the conclusion of the full course of treatment was higher than the RCI), as unchanged if the RCI condition was not fulfilled, and as deteriorated if the RCI condition was fulfilled, but negatively. Additionally, to determine the consensus of therapy termination, we coded whether the therapy was terminated consensually and as planned or otherwise. If a patient stayed away from treatment against therapist recommendation, the termination was considered a drop-out (e.g. the patient stopped showing up and was not available for any further contact or was no longer interested in therapy, despite the therapist's advice to continue). As a result, we formed three groups: Improvement (patients that improved reliably, including both consensual termination and drop-out), non-improvement and consensual termination (patients that terminated therapy consensually despite a lack of change or reliable deterioration) and non-improvement and drop-out (patients that showed no change or reliable deterioration and dropped out of therapy). We split the non-improvement group into the two subgroups according to type of therapy termination in order to better be able to detect the population at risk of dropping out of therapy despite lack of improvement or even deterioration. Besides the applied definition of drop-out, many more can be found in the literature as drop-out is defined quite heterogeneously (e.g. Brogan, Prochaska, &

[1] All RCIs were calculated following Jacobson & Truax (1991):

$RC_{index} = \sqrt{(2*(sd*\sqrt{1-r_{xx}})^2)} * 1,96$

where sd is the standard deviation and r_{tt} is the reliability (internal consistency) of each instrument.

Prochaska, 1999; Beckham, 1992; Maher et al., 2010; Hatchett, Han, & Cooker, 2002). For a summary see Zimmermann, Rubel, Page and Lutz (2016).

Furthermore, we calculated two-level models with patients on level 1 and therapists on level 2 (Schiefele et al., 2016), using the three outcome types defined above as dummy-coded predictors (“improvement” and “non-improvement & drop-out” with “non-improvement & consensual termination” as the reference category) and cNS as the criterion in our random-intercept models, while controlling for the therapeutic relationship. The generic formula, which we applied to all three outcome measures, is presented below:

Level 1: $Synchrony_{ij}=\pi_{0j} + \pi_{1j} * outcome\_measures_{ij} + \pi_{2j} * therapeutic\_relationship_{ij} + e_{ij}$

Level 2: $\pi_{0j}=\beta_{00} + r_{0j}$

$\pi_{1j} = \beta_{10}$

$\pi_{2j} = \beta_{20}$

To test each model against the zero-model, we used -2 Log Likelihood as the information criterion. All analyses were performed using SPSS 24.

5.4 Results

Validation of the Video-Based Procedure

The comparison of genuine and fabricated interactions revealed a significantly higher global value of NS in genuine interactions than in the fabricated pseudointeractions. Significance was reached at the specified .05 level ($M_{synchrony}$=0.15, SD=0.05 vs. $M_{pseudosynchrony}$=0.09, SD=0.01; $t(141)=15.27$, $p<.001$, $d=1.67$).

Next, we attempted to exclude the influence of various possible confounding variables. We found that dyad-type (same- vs. opposite-sex dyads) was no significant predictor of cNS ($Beta_{dyad}$=.67, p=.13). In addition, cNS was confounded by none of the symptom severity measures at intake ($OQ\text{-}30_{pre}$: Beta=-.59, p=.36; BSI_{pre}: Beta=.61, p=.24; $IIP\text{-}12_{pre}$: Beta=-.13, p=.78).

The Relationship between Nonverbal Synchrony and the Therapeutic Relationship

In a first step we discovered that, in line with our assumption, the therapeutic relationship was related to outcome (change scores). The therapeutic relationship at the beginning of treatment (rated from the patient's (rel_pat) and therapist's (rel_th) perspective) positively predicted outcome measured by the OQ-30 ($Beta_{rel\_th}$=.19, $Beta_{rel\_pat}$=.22*), BSI ($Beta_{rel\_th}$=.09, $Beta_{rel\_pat}$=.14) and IIP-12 ($Beta_{rel\_th}$=.24*, $Beta_{rel\_pat}$=.23*), whereas the associations marked by * were significant at the p=.05 level. When the therapeutic relationship was measured at the end of treatment, it significantly positively predicted outcome measured by the OQ-30 ($Beta_{rel\_th}$=.31**, $Beta_{rel\_pat}$=.31**), BSI ($Beta_{rel\_th}$=.32**, $Beta_{rel\_pat}$=.21**) and IIP-12 ($Beta_{rel\_th}$=.32**, $Beta_{rel\_pat}$=.16*). All associations marked by * were significant at the p=.05 level and those marked with ** at the p=.01 level.

Next, we performed an intercept-only model to test for level 2 (therapist) effects in the measurement of the therapeutic relationship. Level 1 (patient) variance was .31, level 2 variance was .03, resulting in an intraclass correlation (ICC) of .09, meaning that 9% of the therapeutic relationship measures' variance was due to differences between therapists. Although the therapist effect was non-significant (Wald Z p=.25), we controlled for it in further analyses. Multilevel modelling revealed that cNS (at the beginning of treatment) does not predict the therapeutic relationship, neither measured at the beginning ($Beta_{rel\_pat}$=.02, p=.46; $Beta_{rel\_th}$=-.01, p=.74) nor at the end of treatment ($Beta_{rel\_pat}$=.00, p=.94; $Beta_{rel\_th}$=-.01, p=.79).

The Relationship between Nonverbal Synchrony, Treatment Outcome and Drop-out

We first investigated the relation between cNS and treatment outcome measured by change scores (pre-post difference). Multilevel modelling revealed no effects of cNS on the outcome using the OQ-30 (Beta=-.02, p=.50), BSI (Beta=-.02, p=.53) or IIP-12 (Beta=.01, p=.64). Next, we investigated the association between cNS and drop-out by performing multilevel modelling and found a marginally significant relation only (Beta=-.02, p=.07).

Subsequently, we investigated the relationship between nonverbal synchrony, treatment outcome (improvement/non-improvement) and drop-out. For this purpose, patients were classified into three groups based on the concept of reliable change (e.g. Jacobson and Truax, 1991; Lutz et al., 2009): 1) Improvement 2) Non-improvement and consensual termination and 3) Non-improvement and drop-out. These outcome types were compared with regard to cNS and when controlling for the therapeutic relationship. We first performed an intercept-only model to test for level 2 (therapist) effects. Level 1 (patient) variance was 5.78, level 2 variance was .96, resulting in an intraclass correlation (ICC) of .14, meaning that 14% of the cNS's variance was due to differences between therapists. Although the therapist effect was non-significant (Wald Z p=.19), we controlled for it in further analyses. Multilevel modelling revealed significant effects of the outcome types on cNS, when controlling for the therapeutic relationship, in OQ-30 (χ^2_{change}=142.29, df_{change}=3, p<.01), BSI (χ^2_{change}=199.38, df_{change}=3, p<.01) and IIP-12 (χ^2_{change}=137.40, df_{change}=3, p<.01). cNS was consistently found to be lowest in the group of patients who did not improve and dropped out early and was significantly lower than cNS in the reference category "non-improvement & consensual termination" when outcome was measured by the OQ-30 (p=.03) and IIP-12 (p=.04). Furthermore, cNS was significantly higher in the group of patients with "non-improvement & consensual termination" than in the group of improved patients when outcome was measured with the OQ-30 (p<.01), see Tables 2 and 3. Altogether, Figure 1 shows cNS being lowest for patients within the category "non-improvement & drop-out", whereas a high level of cNS was associated with "non-improvement & consensual termination". Furthermore, patients within the category "improvement" consistently showed a medium level of cNS (see Figure 2).

5.5 Discussion

Automatically measuring nonverbal synchrony in patient-therapist dyads opens up new possibilities for the assessment of process factors such as congruence in relation to therapeutic change. Although only few studies have focused on nonverbal synchrony in the context of psychotherapy to date, the existing literature is already pointing in a promising direction. While the association with the therapeutic relationship remains heterogeneous, the relationship with therapeutic outcome has been confirmed repeatedly (Ramseyer & Tschacher, 2011; Kupper, Ramseyer, Hoffmann, & Tschacher, 2015; Reich, Berman, Dale, & Levitt, 2014; Galbusera, Finn, & Fuchs, 2016). Nonverbal synchrony constitutes a promising new approach within psychotherapy research, because of its potential to operationalize and therefore enable the empirical study of an aspect of the general psychological construct congruence (Shapiro, 1965), which may constitute a nonverbal aspect of Roger's (1957) therapeutic relationship quality congruence.

The present study examined the validity of a video-based procedure novel to psychotherapy research and the association between nonverbal synchrony and the therapeutic relationship, therapy outcome and drop-out. The association between nonverbal synchrony, measured by a method shown to be valid, and the therapeutic relationship as a common therapeutic factor was close to zero and non-significant for patient- and therapist-rated data. On the one hand, this finding is in line with Ramseyer and Tschacher's (2011) results, which also showed no association when therapists rated the therapeutic relationship. On the other hand, unlike our findings, they found increased nonverbal synchrony to be associated with high relationship quality when patients rated the therapeutic relationship by means of the Bern Post-Session Report (BPSR). In a single psychotherapeutic dyad, Ramseyer and Tschacher (2008) found a positive correlation between the amount of synchronized movement and patient and therapist evaluations of the therapeutic bond, again assessed with the BPSR. It must be noted that the present study and the studies mentioned above all assessed the therapeutic relationship using different instruments, which is likely one explanation of these discrepancies.

Another possible explanation relates to the measurement method itself. Various measurement methods are described in the literature (e.g. Altmann, 2013; Boker, Rotondo, Xu, & King, 2002; Grammer et al., 1999; Ramseyer & Tschacher, 2011), the program codes of which unfortunately remain to be published. It is evident that varying methods of measuring pixels changes and calculating nonverbal synchrony most likely lead to inconsistent study results. Taken together, these findings raise the question whether or not, and if so in which direction, nonverbal synchrony is associated with the therapeutic relationship measured via questionnaires. This area requires further investigation, which should be based on the application of homogeneous instruments and measurement methods, enabling meaningful comparisons and explanations of the heterogeneous results found so far.

A further explanation of the contradictory findings could be the skewed distribution of therapeutic relationship ratings (very high average). A Kolmogorov-Smirnov test indicated a non-normal distribution ($p=.005$) of therapeutic relationship ratings. 95.5% of ratings of the therapeutic relationship ranged between 3.49 and 5.65 ($m=4.57$) when rated by the therapist and from 3.24 to 5.68 ($m=4.46$) when rated by the patient (scale 1-6). Attempts to transform relationship values (log, ln, $\sqrt{x}$, x2) remained unsuccessful; a normal distribution could not be generated and correlations with nonverbal synchrony remained small and non-significant. However, we did find a significant difference between the observed and uppermost possible scores, which fails to support the assumption of a ceiling effect. Future research is needed to illuminate the association between the therapeutic relationship and nonverbal synchrony with additional measures.

Besides these measurement-related issues, it is also plausible that questionnaire ratings of the therapeutic relationship and video-analyzed nonverbal synchrony measure different aspects of the therapeutic relationship as a whole (questionnaire ratings measuring the patients' and therapists' subjective perceptions of the relationship and nonverbal synchrony measuring an aspect of the accordance of nonverbal behaviors, which may not be as easily consciously accessed). As a result, it is possible that these two different aspects of the therapeutic relationship may not correlate with one another. We did however find an association between nonverbal synchrony and drop-out, which may express alliance ruptures, a further component of the therapeutic relationship (Lutz et al., 2013; Muran et al., 2009). In future research, an important question will be how alliance ruptures and nonverbal synchrony are related.

Interestingly, nonverbal synchrony was not directly associated with patient outcome (measured by change scores), but rather with outcome categories based on drop-out and the concept of reliable change (e.g. Jacobson and Truax, 1991; Lutz, Stulz, Martinovich, Leon, & Saunders, 2009). We found the lowest level of synchrony in dyads with patients who dropped out of therapy with non-improvement. Furthermore, the highest level of nonverbal synchrony was found in dyads, in which therapies were terminated consensually despite non-improvement. In dyads in which patients improved during therapy, a medium level of nonverbal synchrony was observed. These results indicate that a medium level of nonverbal synchrony between the patient and therapist is associated with successful therapies. Findings like this go in line with the mutual regulation model of dyadic meaning-making (Tronick & Beeghly, 2011), stating that dyadic interactions are not only characterized by continuous matching, but rather by alternating periods of dyadic matching, mismatching and reparation, as typical interactions are not "perfect" but rather "messy".

Patients who drop out of therapy often criticize a lack of validation and support from their therapists (Lambert & Ogles, 2004) and describe them as passive, indifferent and unsympathetic (Kolb, Beutler, Davis, Crago, & Shanfield, 1985; Mohl, Martinez, Ticknor, Huang, & Cordell, 1991; Reis & Brown, 1999). A low level of nonverbal synchrony could be a manifestation of these subjective perceptions and feelings. On the other hand, a very high level of nonverbal synchrony may represent overadaption or sympathy - both ensuring, that the patient stays in therapy, but not necessarily ensuring that therapy is successful. The patient's overadapting behavior may be crucial here as results held even when controlling for the therapeutic relationship, revealing that nonverbal synchrony provides additional information on outcome beyond self-report measures of the therapeutic relationship. Patients who adapt less (showing low nonverbal synchrony at the beginning of therapy) may recognize a negative outcome in therapy (i.e. a lack of change or even deterioration) and terminate therapy early. On the other hand, patients who overadapt (showing high nonverbal synchrony at the beginning of therapy) may continue therapy until the official end (i.e. until all allocated sessions are completed), even if they perceive a negative outcome. From this perspective, nonverbal synchrony may be a useful tool to detect patients at risk (Rubel et al., 2014).

Limitations

The automatic measurement method applied and validated in this study is its main strength, but is also associated with some limitations. The video analysis of movement behavior is independent of specific corresponding gestures and postures. This means we were able to measure and calculate movements that occurred at the same time, causing pixel changes, yet we do not know whether simultaneous movement of the patient and therapist was substantially related to one another or rather coincidental. Concurrently, in contrast to previous research, we calculated pseudosynchrony to conservatively control for spurious correlations. Furthermore, studies in social and developmental psychology have long used these methods for the measurement of nonverbal behavior, showing reliable and promising results (e.g. Watanabe, 1983; Grammer, Honda, Juette, & Schmitt, 1999; Koppensteiner & Grammer, 2010; Tschacher, Rees, & Ramseyer, 2014).

Furthermore, the applied definition of drop-out constitutes another limitation as it is only one of many (e.g. Brogan, Prochaska, & Prochaska, 1999; Beckham, 1992; Maher et al., 2010; Hatchett, Han, & Cooker, 2002), for a summary see Zimmermann, Rubel, Page and Lutz (2016). Another definition for example, quite departing from the applied one, refers to selecting only patients within the clinical range at the beginning of treatment and defining drop-out as not reaching reliable change. Yet another operationalization might refer to not clustering outcome types but predicting change in the applied outcome measures by cNS together with drop-out. We did try that definition too but could not find reliable results. Overall, various definitions produce varying drop-out rates (Swift & Greenberg, 2012) and findings might change if different criteria were applied. Nevertheless, our goal was to define outcome and drop-out within one integrated composite index, which includes a categorical definition of response and drop-out in one model and which made us able to include the full sample and a simpler model, comparable to a univariate ANOVA, including drop-out together with reliable change. It was especially important to us to make a distinction between non-improving patients who drop out and those, who continue therapy nonetheless as this might reflect some relevant patient differences, which could be picked up by the cNS method.

Another limitation pertains to missing survey data at the end of therapy, especially from patients who dropped out. Therefore, the outcome types' sample sizes were partially small (particularly "non-improvement & drop-out"), reducing the chances of detecting significant effects. This kind of missing survey data is a frequent problem (e.g. Little et al., 2012), which is mainly due to patients' lack of motivation to fill out questionnaires after having decided to abort therapy.

Conclusion and Future Directions

Beyond these limitations, this article provides researchers and clinicians with a valid new video-based measurement approach, which operationalizes an aspect of nonverbal behavior accordance, providing new access to aspects of the therapeutic relationship, which has long been investigated as the probably most important common factor. This investigation of old concepts from a new perspective leads to an increase of knowledge. For example, our results suggest that a medium level of nonverbal synchrony is important for successful therapies.

Studies such as ours suggest that the provision of a corrective relationship and associated emotional experiences, which is the aim of therapy in most therapeutic approaches, also takes place on a nonverbal level. Therefore, subtle differentiation of body synchrony may theoretically be one way therapists can improve therapy outcomes and avoid drop-out. However, it remains unclear, to which degree individuals are able to consciously perceive nonverbal synchrony. In the future, it is therefore conceivable that automatically measured nonverbal synchrony could be reported back to therapists, allowing them to become more aware of their own nonverbal behavior in contact with the patient. Alongside psychometric feedback, the feedback of nonverbal synchrony could also be used as a warning signal for deteriorating patients or premature terminations of therapy, thus positively affecting outcome (e.g. in a training or supervision context, Lutz et al., 2015).

However, first psychotherapy research must refine the measurement methods and answer some diagnosis-specific questions, as it is plausible that nonverbal synchrony depends on the diagnosis (i.e. patients with specific diagnoses may have specific nonverbal synchrony characteristics). Depressed patients, for example, may show a lower level of nonverbal synchrony than other patients, because of reduced psychomotor activity. It is also possible that patients suffering from social phobia may show a higher level of nonverbal synchrony, because of their self-consciousness and tendency to adapt to others. Furthermore, it must be clarified, which level of synchrony is “advantageous” at which point of time in therapy.

In summary, future directions for researchers should emphasize the advancement of video-based measurement methods. There is much to be learned from studying nonverbal behavior in the context of psychotherapy. Therefore, we encourage researchers to develop this neglected field of investigation.

5.6 Tables and Figures

Table 1

Sample characteristics

Variable	Mean or %	Range or N
Patient age (years)	36.5	16-68
Patient sex (female)	54.5	78
Therapist sex (female)	66.7	18
Therapy duration (sessions)	38.4	6-82
Drop-out frequency	16.1	23
Drop-out after session number	23.7	6-56
Comorbidity		
Patients with one diagnosis	34.3	49
Patients with two or more comorbid diagnoses	65.7	94
Primary diagnosis		
Affective disorder	53.1	76
Anxiety disorder	28.7	41
Adjustment disorder	7.7	11
Eating disorder	2.8	4
Personality disorder	0.7	1
Other	7.0	10
Marital status		
Single	58	83
Married	26.6	38
Divorced/separated	13.3	19
Widowed	1.4	2
Education		
Lower secondary education certificate	26.6	38
Intermediate secondary education certificate	23.1	33
General qualification for university entrance	46.2	66
Still in school	0.7	1
No school-leaving certificate	2.1	3
Employability		
Not working because of sick leave	17.5	25

Note: Marital status was available for N=142 patients (99.3%).

Table 2

Values of nonverbal synchrony at the beginning of therapy by outcome type

Measures of therapeutic process	Outcome type	*n*	cNS_{mean}
OQ-30	Improvement	88	3.77
	Non-improvement & consensual termination	32	5.02
	Non-improvement & drop-out	16	2.80
BSI	Improvement	54	3.75
	Non-improvement & consensual termination	43	4.40
	Non-improvement & drop-out	21	2.94
IIP-12	Improvement	32	3.67
	Non-improvement & consensual termination	83	4.01
	Non-improvement & drop-out	20	2.63

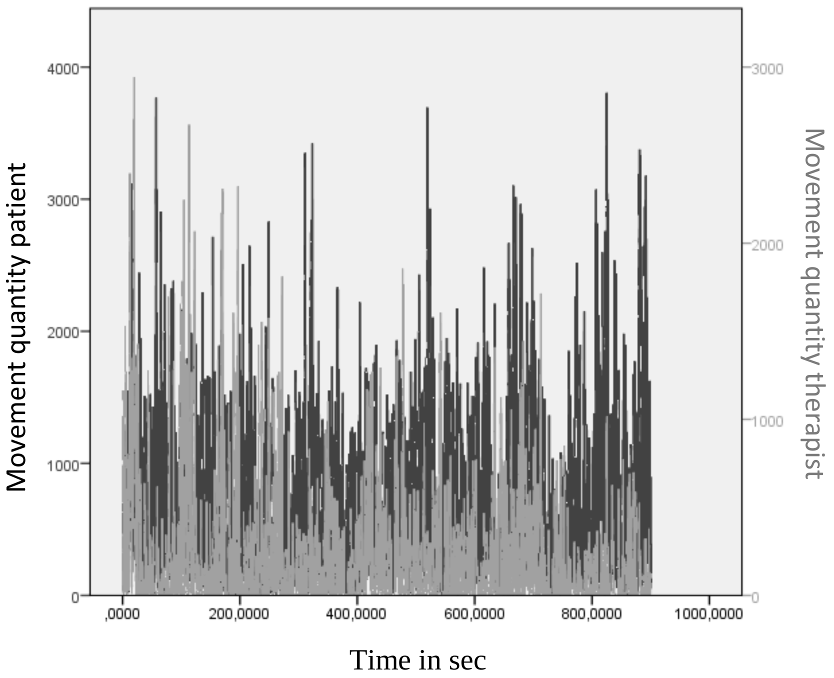
Note: OQ-30 = Outcome Questionnaire, BSI = Brief Symptom Inventory, IIP-12 = Inventory of Interpersonal Problems, cNS = corrected nonverbal synchrony.

Table 3

Fixed effects for random intercept model examining the associations between nonverbal synchrony, therapy outcome and drop-out (when controlling for the therapeutic relationship)

Fixed effects	Parameter estimates	Std. error	t value	p	Patient variance	Therapist variance	AIC
OQ_intercept	1.84	2.13	.86	.39	5.41	1.03	500.64
OQ_non-improvement & drop-out	-2.14	.95	-2.24	.03			
OQ_improvement	-1.79	.64	-2.81	.006			
therap. rel. (HAQ)	.65	.42	1.53	.13			
BSI_intercept	3.11	2.44	1.28	.21	5.83	.64	443.55
BSI _ non-improvement & drop-out	-1.46	.81	-1.80	.07			
BSI _improvement	-.69	.56	-1.22	.23			
therap. rel. (HAQ)	.25	.47	.54	.59			
IIP_intercept	1.98	2.17	.91	.37	5.68	.98	505.53
IIP _ non-improvement & drop-out	-1.58	.77	-2.06	.04			
IIP _improvement	-.21	.55	-.38	.71			
therap. rel. (HAQ)	.37	.42	.89	.37			

Note: OQ = Outcome Questionnaire, BSI = Brief Symptom Inventory, IIP-12 = Inventory of Interpersonal Problems, outcome type "non-improvement & consensual termination" was set as the intercept for each outcome instrument.



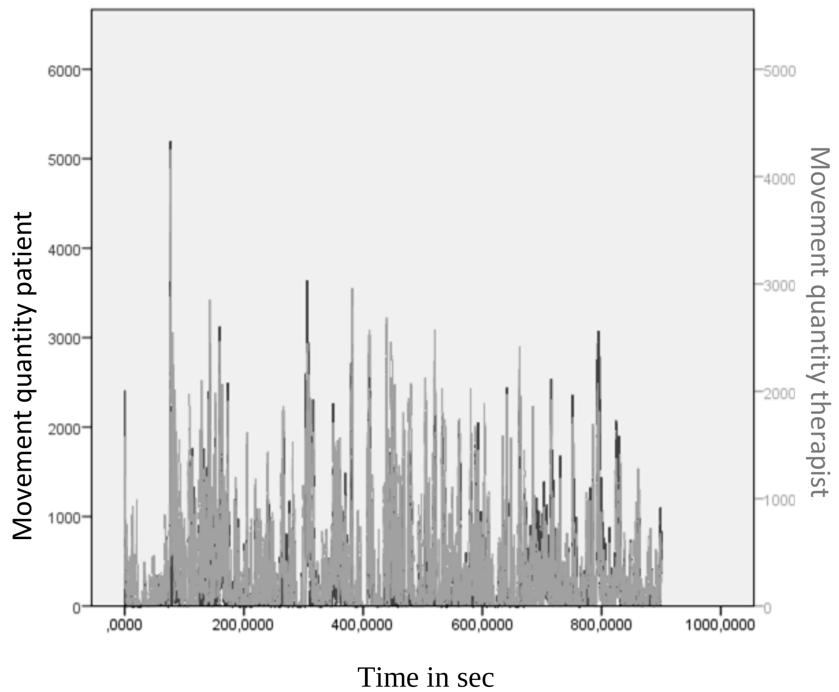


Figure 1. Examples of nonverbal synchrony. The upper figure shows a dyad with low nonverbal synchrony (r=.06) at the beginning of therapy and a subsequent drop-out with non-improvement. The lower figure shows high nonverbal synchrony (r=.37) at the beginning of therapy, as both lines nearly completely overlap. This patient's therapy was terminated consensually despite non-improvement.

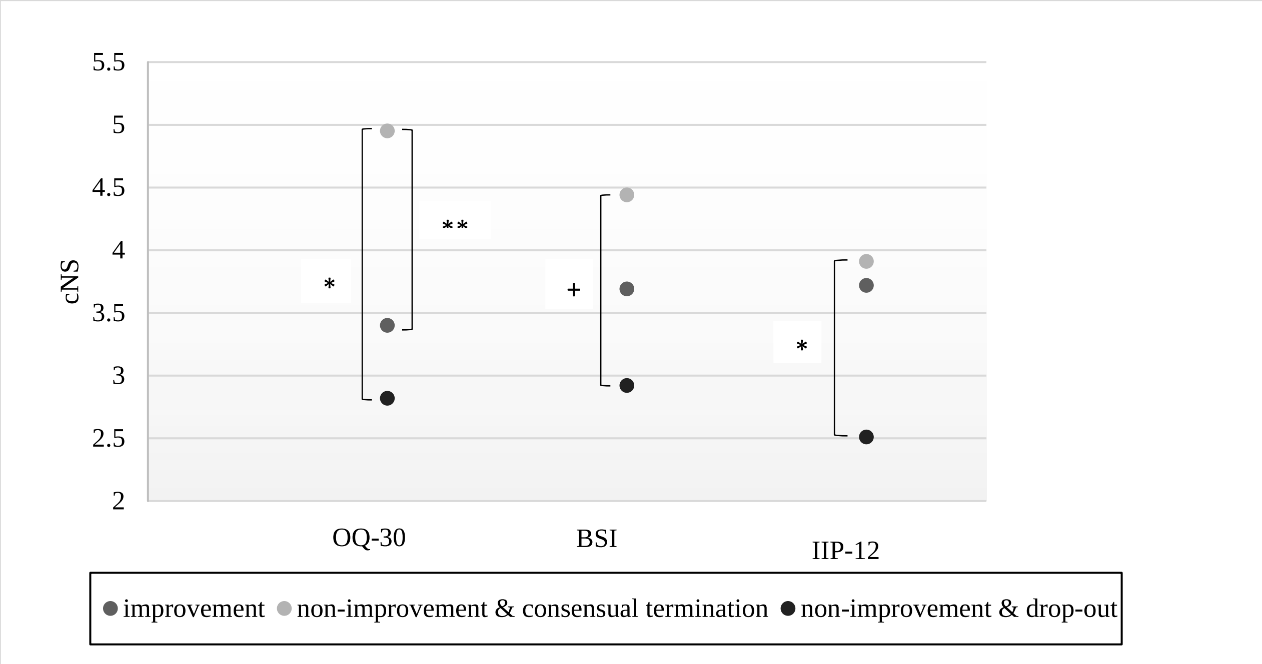


Figure 2. Results of mixed models investigating differences in nonverbal synchrony at the beginning of therapy between the outcome types improvement, non-improvement & consensual termination and non-improvement & drop-out. OQ-30 = Outcome Questionnaire, BSI = Brief Symptom Inventory, IIP-12 = Inventory of Interpersonal Problems, cNS = corrected nonverbal synchrony (significant differences in mixed models are marked by $p<.10^{+}$, $p<=.05*$, $p<=.01**$).

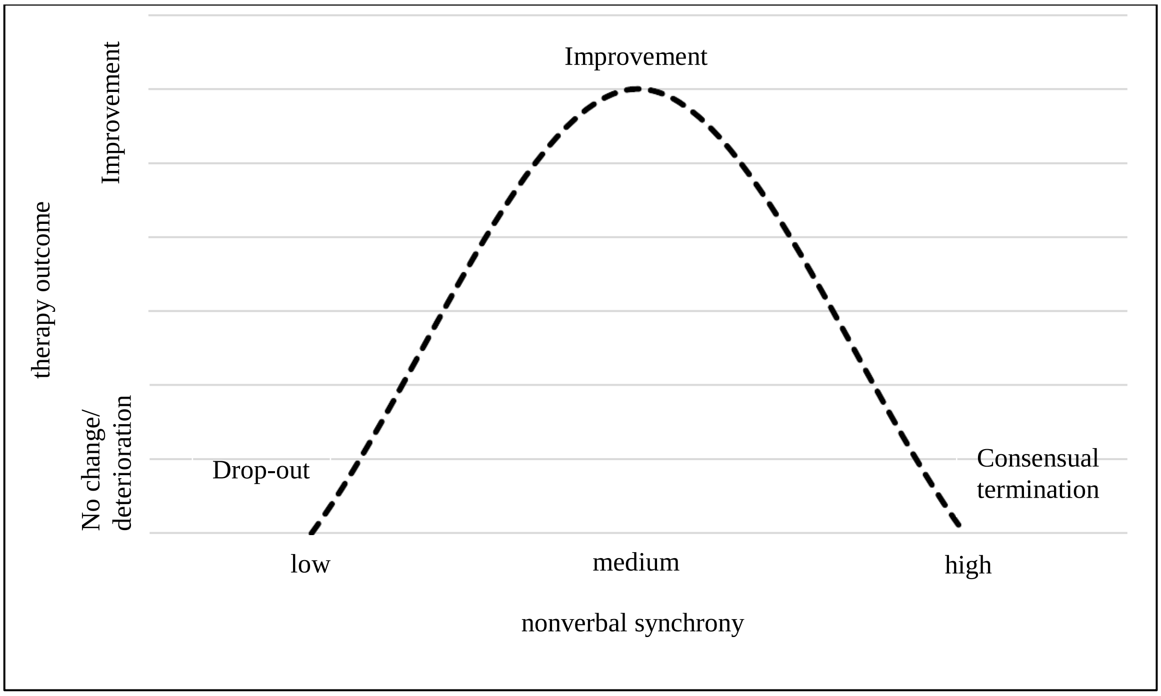


Figure 3. Relationship between nonverbal synchrony, therapy outcome and drop-out.

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6 Study II: Diagnostic Features of Nonverbal Synchrony in Psychotherapy: Comparing Depression and Anxiety

Paulick, J., Rubel, J., Deisenhofer, A.-K., Schwartz, B., Thielemann, D., Altmann, U., Boyle, K., Strauß, B., & Lutz, W. (2018). Diagnostic Features of Nonverbal Synchrony in Psychotherapy: Comparing Depression and Anxiety. *Cognitive Therapy and Research*, Advance online publication. doi:10.1007/s10608-018-9914-9

6.1 Abstract

Background: It has been repeatedly shown that interacting persons synchronize their affective, physiological, verbal and nonverbal responses, especially when they are engaged in positive interaction. Nonverbal synchrony (assessed by automated measurement of videotaped movements) is a new concept in psychotherapy research, which has been associated with alliance, self-efficacy and outcome. However, there is a lack of knowledge regarding diagnostic differences in nonverbal synchrony. In this study, we investigated diagnosis and movement quantity as predictors of nonverbal synchrony.

Methods: The naturalistic analysis sample consisted of 173 videotaped sessions of patients with a depressive disorder (N=68) and an anxiety disorder (N=25), who were treated with cognitive behavioral therapy at an outpatient clinic in southwest Germany. Therapy videos were routinely collected and nonverbal synchrony was computed using Motion Energy Analysis (MEA). Using multilevel modeling, we first investigated the influence of diagnosis and time of assessment on patient and therapist movement quantity. Second, we predicted nonverbal synchrony by diagnosis and time of assessment, while controlling for patient movement quantity.

Results: We found a lower quantity of movement in depressive than in anxious patients. At the beginning of therapy, nonverbal synchrony was lower in dyads with depressive patients, even when controlling for patient movement quantity. At the end of therapy, patients with depression and anxiety no longer differed as nonverbal synchrony increased in depression and decreased in anxiety during the course of therapy.

Conclusions: Nonverbal synchrony provides further information beyond psychomotor retardation and is discussed with regard to patients' range of affect and attention focus.

Keywords: nonverbal synchrony, depression, anxiety, movement quantity, outcome

6.2 Introduction

In social interactions, persons tend to synchronize their neural, perceptual, affective, physiological and behavioral responses (Repp & Su, 2013; Semin & Cacioppo, 2008; Wheatley et al., 2012), breathing patterns (McFarland, 2001; Warner, 1996; Wei-Dong, 2007) and word use including content and even function words (Ireland & Pennebaker, 2010; Pickering & Garrod, 2004). They also synchronize their postural sway and each other’s eye gaze, even when they cannot see their partner (Brown-Schmidt & Tanenhaus, 2008; Richardson et al., 2007; Shockley et al., 2003). This synchronization between interacting partners is called interpersonal synchrony and is considered a marker of involvement in an interaction (Paladino et al., 2010; Pinel et al., 2015). It is assumed that interpersonal synchrony usually occurs in interactions unconsciously, but is facilitated by the presence of a positive relationship (Koole & Tschacher, 2016). Nonverbal synchrony is the most basic form of interpersonal synchrony as it refers to the synchronization of nonverbal behavior between interacting persons. The term *nonverbal synchrony* was first used by Condon and Ogston (1966), who defined it as the movement coordination of two interacting persons.

Overall, research in developmental and social psychology has shown that nonverbal synchrony in dyads is associated with higher relationship quality, accordance, and better development. Early studies in developmental psychology investigated mother-neonate interactions, finding nonverbal synchrony to be associated with intimacy in interactions (Bernieri et al., 1988; Feldman, 2007; Watanabe, 1983) and children’s social competence

(Lindsey et al., 1997). In social psychology, studies have been able to show a positive association between nonverbal synchrony and fondness between interaction or dating partners (Chartrand & Bargh, 1999; Grammer et al., 1999), a secure attachment style in interactions with a dating partner (Tucker & Anders, 1998), shared interest in a topic (Katsumata et al., 2009) and positive affect (Altmann, 2011; Tschacher et al., 2014). A newer study investigated the duration of nonverbal synchrony, termed nowness, finding a longer duration to be associated with personality attributes such as higher openness to experience, higher avoidant attachment und lower narcissistic interpersonal style (Tschacher et al., 2016).

In psychotherapy research, most previous studies have primarily focused on verbal aspects (commonly measured using psychometric instruments) such as investigations in psychotherapy process research on typical change patterns of psychotherapy patients (Lutz et al., 2013, 2014; Rubel et al., 2015). However, less attention has been payed to nonverbal aspects and only a few studies have focused either on the nonverbal behavior of the patient or the therapist, showing, for example, that the nonverbal behavior of the therapist is important for the formation of the therapeutic relationship (Hall, Harrigan, & Rosenthal, 1995). However, there has been little research on nonverbal interaction in patient-therapist dyads. A reason for the lack of research interest in nonverbal aspects may have been the difficulty of measuring nonverbal synchrony. With new technical developments, it is now possible to measure nonverbal behavior automatically and objectively (Altmann, 2013; Grammer et al., 1999; Katsumata et al., 2009; Tschacher et al., 2014). As a result, research on nonverbal aspects is constantly growing, which is also reflected by new therapeutic approaches such as embodiment (Michalak et al., 2014; Tschacher & Pfammatter, 2016).

In the field of psychotherapy research, nonverbal synchrony has previously been understood to be a nonverbal aspect of process factors such as the therapeutic relationship (Ramseyer & Tschacher, 2011) and congruence (Paulick et al., 2017). It has been shown that nonverbal synchrony is associated with self-efficacy and therapeutic outcome (Tschacher & Pfammatter, 2016), whereas a medium level of synchrony at the beginning of therapy seems to be advantageous for therapeutic success (Paulick et al., 2017). High and low levels of synchrony are associated with poor outcome and may be interpreted as the patient's tendency to over- or underadapt to the therapist. Nonverbal synchrony may help to establish the alliance, endorsing patients' adaptive emotion regulation and promoting a good therapeutic outcome (Koole & Tschacher, 2016). In summary, nonverbal synchrony can be conceptualized as a nonverbal aspect of relationship factors and is therefore relevant to therapeutic outcome. Simultaneously, it remains unclear, how diagnostic aspects influence nonverbal synchrony.

Until now, only few studies have examined the influence of patient diagnosis on nonverbal synchrony. In schizophrenia patients, a lower level of nonverbal synchrony was found to be indicative of more negative symptoms (Galbusera et al., 2016), lower social competence, impaired social functioning and a lower patient self-evaluation of competence (Kupper et al., 2015). Kupper et al. (2015) corrected the measures of nonverbal synchrony for the relative amount of patient movement, assuming that nonverbal synchrony provides additional and specific information about patient functioning beyond psychomotor retardation. Apart from these, there is lack of studies investigating diagnosis-specific patterns in nonverbal synchrony. However, this focus seems to be especially important as diagnoses with psychomotor disturbances, such as depression or anxiety, could possibly have effects on patients' ability to nonverbally synchronize.

Depression is one of the most common mental disorders and besides disturbances of mood, affect and avolition, the disorder is also characterized by a distinct pattern of psychomotor deficits such as psychomotor retardation (American Psychiatric Association, 2000). Former studies have repeatedly revealed that depressive patients move less than other patients. Investigations of gait patterns in depressed patients have shown a more slumped posture and reduced walking speed, arm swing, swaying movements of the upper body and vertical head movements (Michalak et al., 2009). So far, most research on motion patterns has focused on facial expression, while only few studies have investigated gait patterns, i.e. a kind of full body movement, in association with depression (e.g. Lemke et al., 2000; Paleacu et al., 2007; Wendorff et al., 2002). These studies were able to show that depressed patients have a lower gait velocity and stride length as well as an enhanced gait cycle duration and standing phase length. In a review (Schrijvers et al., 2008), 13 studies investigated gross motor activity of depressive persons measured with actometers, whereas only one study of those reviewed examined psychomotor activation. For example, it was found that depressive patients show a lower motor activity level during wake time and a higher during sleep in comparison to non-depressive persons (Volkers et al., 2002). Furthermore, it could be shown that patients with major depression display reduced motor activity (Lemke et al., 1997), bright light exposure and an altered circadian rhythm in comparison to healthy control participants (Armitage et al., 2004).

Studies on anxiety disorders have been able to show that patients with anxiety also have specific nonverbal cues such as trembling hands and more rigid and less flexible torso movements (Waxer, 1977). Furthermore, trembling is a diagnostic criterion for most anxiety disorders (American Psychiatric Association, 2000). A relation has also been found between anxiety and increased self-adaption, which refers to self-manipulation or movements on one’s body such as rubbing, squeezing, picking, scratching, covering or playing (Ekman & Friesen, 1972). In addition, patients with social phobia have been found not only to show less eye contact, but also more restless movements of their arms, legs, hands, body and head (Clark & Wells, 1995; Kang et al., 2012). For generalized anxiety disorder, an increased muscular tonus in comparison to non-anxious persons has been found (Hazlett et al., 1994).

In summary, it has repeatedly been shown that patients with depression and anxiety have salient pathological movement patterns – patients with anxiety disorders display enhanced restlessness, whereas depressive patients are rather marked by reduced nonverbal activity. So far, it remains unclear, whether these nonverbal or psychomotor deviations affect patients' ability to nonverbally synchronize with their therapists. Recent research has revealed that nonverbal synchrony (in schizophrenic patients) provides information on social functioning beyond psychomotor retardation as an effect was still present when the amount of movement was controlled for (Kupper et al., 2015). In this sense, nonverbal synchrony in depressive patients (when it is adjusted for measures of psychomotor retardation) may reflect a measure of internal attention focus (especially on dysfunctional thoughts), affecting the patient's ability to be in emotional contact with the therapist (e.g., Beck, 1979; Salovey & Mayer, 1990). Following this idea, an external attention focus in anxious patients (on the conversational partner or external risks; e.g., Ingram & Smith, 1984; Mor & Winquist, 2002) may also be expressed in measures of nonverbal synchrony. To date, no other study has investigated the influence of depression and anxiety on nonverbal synchrony (when controlling for movement quantity), making our study especially relevant to furthering the understanding of nonverbal synchrony. It aims to refine previous findings referring to nonverbal synchrony in outpatient psychotherapy (e.g., Paulick et al., 2017; Ramseyer & Tschacher, 2011) by focusing on diagnostic issues.

The main aim of this study is to investigate the influence of depression and anxiety on nonverbal synchrony and the influence of movement quantity (considered a measure of psychomotor retardation/agitation) on that assumed relation. Therefore, on the basis of previous research, we first hypothesize that depressive patients move less than anxious patients at the beginning of therapy. Furthermore, we assume the movement quantity of depressive patients to increase and that of anxious patients to decrease, resulting in no further difference between the groups at the end of therapy. Second, we assume dyads with depressive patients will show lower nonverbal synchrony at the beginning of therapy than dyads with anxious patients. Again, we assume the nonverbal synchrony of dyads with depressive patients to increase and that of dyads with anxious patients to decrease, resulting in the groups no longer differing at the end of therapy – even when controlling for patient movement quantity. Previous research has come to diverse results concerning the effect of patient and therapist gender (same- vs. opposite-sex dyads) on nonverbal synchrony: Whereas Ramseyer and Tschacher (2011) only analyzed same-sex dyads assuming opposite-sex dyads to be less prone to nonverbally synchronize, Paulick et al. (2017) found no gender-specific differences. To further understand the effects of dyad types, we also investigated sex as a predictor of nonverbal synchrony.

6.3 Methods

Participants and Treatment

The sample consisted of 93 patients (25 with an anxiety disorder and 68 with a depressive disorder as the main diagnosis). We used 173 videotaped sessions from these patients: 89 sessions (range: session 3-12) from the beginning of each therapy (defined as the first third) and 84 sessions (range: session 13-83) from the end of each therapy (defined as the third third). Patients were included from 18 years up (M= 36.8 years, range= 20–68) and the majority was female (53.8%). Patients were treated by 23 therapists (65.2% female, mean age: 31.1 years, 1-9 patients, mean= 4.1 patients), who all participated in a 3-5 year postgraduate training program with a cognitive-behavioral therapy (CBT) focus. Therapies were conducted between 2007 and 2013 at an outpatient clinic in southwest Germany, where research data is routinely collected and therapy sessions are consistently videotaped. All patients and therapists included in the study consented to the use of their data (therapy videos and psychometric data) for research, but were naive to the study goals.

Patients were diagnosed based on the Structured Clinical Interview for Axis I DSM-IV Disorders (SKID-I; Wittchen et al., 1997) and were conducted by intensively trained independent clinicians before actual therapy began. The interviews were videotaped and subsequently interviews and diagnoses were discussed in expert consensus teams comprised of four senior clinicians. Final diagnoses were determined by consensual agreement of at least 75% of the team members. Table 1 provides an overview of sample characteristics.

The two diagnostic groups were formed using the following inclusion criteria: All patients with a depressive episode (n=23), recurrent depressive disorder (n=27), dysthymia (n=12) or adjustment disorder with depressive reaction (n=6) as the main diagnosis where categorized as “depression” (n=68). All patients with a phobic disorder (specific or social; n=7), panic disorder (n=5), agoraphobia (n=8), generalized anxiety disorder (n=3) or obsessive-compulsive disorder (n=2) as the main diagnosis were included in the group “anxiety” (n=25). Patients with comorbid depressive disorders were excluded as well as patients diagnosed with a comorbid manic episode, psychosis or substance dependency (see Fig. 1). We assumed that these disorders have severe effects on nonverbal behavior (Galbusera et al., 2016; Kupper et al., 2015), which could distort our data.

After prescreening, videos were excluded according to the following criteria: a) patient transfer to a different therapist during the course of therapy, b) low video quality (e.g. consistently flickering video, strong light changes) and c) patient or therapist left their seating place during the first 15 minutes of the relevant video sequence (their movements could no longer be analyzed, because they moved out of the camera’s focus). For further analyses, we used the first 15 minutes of each therapy session, because later on the interaction was frequently interrupted by the use of white boards or roleplays (where patient and therapist left their seating places). Former studies were able to demonstrate that the correlation between nonverbal synchrony during the first 15 minutes of the therapy session and the entire 50 minutes of the session is highly significant and above r = .80 (Paulick et al., 2017; Ramseyer & Tschacher, 2011).

Measurement of Nonverbal Behavior via Motion Energy Analysis (MEA)

All therapy sessions were recorded using two cameras joined into a split-screen image. Video quality was ensured through a static camera position, stable light conditions and digitized film material. Nonverbal synchrony was measured via an objective and automated video analysis algorithm called Motion Energy Analysis (MEA, Ramseyer & Tschacher, 2011; Ramseyer, 2016). MEA detects the frame rate of the respective video (here, 10 frames per second) and then computes the differences in grey scale pixels between the sequential video frames for each interacting person according to the definition of motion energy (Grammer et al., 1999). In MEA, a threshold (we used the default of 10) for movement detection may be set, so that values under this threshold, which could be due to minimal light changes or video noise, are automatically excluded from the analyses. In line with the original study employing MEA (Ramseyer & Tschacher, 2011), we defined the upper body beginning at the seat of the chair as a specific region of interest (ROI), as the patients' and therapists' legs were often covered by the table or one person's feet were visible on the others person's split screen.

The raw data output from MEA is a time series of pixel changes for each ROI, which must be pre-processed before the quantification of synchrony. First, to reduce fluctuations due to signal distortion, the time-series were smoothed with a moving average of 0.4 seconds. After that, data were z-transformed in order to account for differently sized regions of interest. Then a threshold for minimal movement was calculated for each person's region of interest (for details, see Grammer et al., 1999) using the statistic software R version 3.3.2 (R Core Team, 2016).

Quantification of Nonverbal Synchrony. Afterwards, the corrected motion energy time series (as described above) were cross-correlated in window segments of a one minute duration (for each window, cross-correlations were computed for positive and negative time lags of up to five seconds in steps of 0.1 second). Subsequently, these cross-correlations were standardized with Fisher's Z and their absolute values were aggregated to a global value of nonverbal synchrony for each 15-minute video sequence. To control for coincidental synchrony, we generated pseudointeractions (interactions that never actually took place) on short time scales by using automated surrogate testing algorithms according to the procedures described by Ramseyer & Tschacher (2010). We did so by recombining one minute segments of the time series of patient and therapist to create surrogate datasets (n=100 out of each genuine dataset). Therefore, we created artificial time series with movement energy that never took place. The nonverbal synchrony of these shuffled datasets was calculated identically to the synchrony of the original datasets as described above. Former studies have repeatedly been able to confirm that pseudosynchrony calculated in this manner is significantly lower than the raw scores of nonverbal synchrony (e.g. Paulick et al., 2017; Ramseyer & Tschacher, 2011). Pseudosynchrony values are used to calculate an adjusted value of nonverbal synchrony, which is corrected for the session's specific spurious correlations (see data analytic strategy).

Quantification of Movement Quantity. Movement quantity was investigated in relation to patient diagnosis and nonverbal synchrony. It was calculated as the proportion of time spent moving (Kupper et al., 2015) again for each patient and therapist at the beginning and at the end of treatment. Values of movement quantity are percentages (e.g. a movement quantity of .80 means that someone moved 80% of the time).

Instruments

Brief Symptom Inventory (BSI). Symptom severity was measured using the BSI (Franke, 2000; German translation of Derogatis, 1975), which was applied as an outcome instrument. This 53-item self-report inventory is the brief version of the Symptom Check-List-90-Revised (SCL-90-R; Derogatis, 1975) and assesses psychological and physical symptoms within the last week. Items are based on a 5-point Likert scale ranging from 0 ("not at all") to 4 ("extremely"). The psychometric properties of the Global Severity Index

(GSI), which was used to evaluate symptom change in the sample, can be regarded as excellent: Franke (2000) reports an internal consistency of α = .92 (in our sample it was α = .96) and a retest-reliability of $r_{tt} = .90$.

Data Analytic Strategy

In order to reduce artefacts due to incidental effects, we used an adjusted value of nonverbal synchrony (cNS) for all analyses (instead of the raw scores of nonverbal synchrony), which is corrected for the session's specific pseudosynchrony. As such: corrected nonverbal synchrony (cNS) = (global value of NS – pseudosynchrony)/ SDpseudosynchrony. Raw scores of nonverbal synchrony represent correlation coefficients, whereas cNS constitutes a z-transformed variable, which can be regarded as an effect-size estimate referring nonverbal synchrony in relation to pseudosynchrony. Thus, it can be compared to the values published in other studies on nonverbal synchrony (e.g., Ramseyer & Tschacher, 2011). Mean values for NS, pseudosynchrony and cNS are presented in Table 2.

As patients were nested within therapists, multilevel models were employed, which are recommended as the method of choice for hierarchical data (Hox, 2010; Lutz et al., 2007). We calculated two-level models with patients on level 1 and therapists on level 2 (e.g. Schiefele et al., 2016). To test for level 2 (therapist) effects on movement quantity and nonverbal synchrony, we performed intercept-only models. The therapist effect was calculated by dividing level 2 variance through total variance resulting in an intraclass correlation (ICC), which is a measure of the therapist effect (Hox, 2010).

First, to investigate differences in movement quantity for depression and anxiety, we used patient diagnosis (0 'anxiety', 1 'depression'), time of assessment (0 'beginning of treatment', 1 'end of treatment') and their interaction term as dummy coded predictors and both movement quantity measures (of the patient and of the therapist) as criteria in our random-intercept models. The generic formula, which we applied to both movement quantity measures, is presented below:

Level 1: $movement\_quantity_{ij} = \pi_{0j} + \pi_{1j} * diagnosis_{ij} + \pi_{2j} * time\_of\_assessment_{ij} + \pi_{3j} * time\_of\_assessment_{ij} * diagnosis_{ij} + e_{ij}$

Level 2: $\pi_{0j} = \beta_{00} + r_{0j}$

$\pi_{1j} = \beta_{10}$

$\pi_{2j} = \beta_{20}$

$\pi_{3j} = \beta_{30}$

Second, we investigated differences in nonverbal synchrony between depression and anxiety. To test ‘sex’ as a possible confounding variable on nonverbal synchrony, we primarily investigated the effects of patient gender, therapist gender and dyad type (same- vs. opposite-sex) on nonverbal synchrony (measured at the beginning of treatment) in a random-intercept model. As these variables had no significant influence (see results section), we did not control for ‘sex’ in further analyses. Furthermore, to investigate systematic differences in session numbers of each time of assessment in both diagnostic groups, we calculated an independent t-test with diagnosis as the independent variable and the amount of sessions that lapsed between pre and post measure as the dependent variable.

Next, we used the dummy coded predictors diagnosis (0 ‘anxiety’, 1 ‘depression’), time of assessment (0 ‘beginning of treatment’, 1 ‘end of treatment’), their interaction term as well as patient movement quantity as predictors and cNS as the criterion in our random-intercept model. To test the predictor model against the zero-model, we used the Akaike Information Criterion (AIC). The following formula represents our two-level random-intercept model:

Level 1: $synchrony_{ij} = \pi_{0j} + \pi_{1j} * diagnosis_{ij} + \pi_{2j} * time\_of\_assessment_{ij} + \pi_{3j} * time\_of\_assessment_{ij} * diagnosis_{ij} + \pi_{4j} * movement\_quantity\_pat_{ij} + e_{ij}$

Level 2: $\pi_{0j} = \beta_{00} + r_{0j}$

$$\pi_{1j} = \beta_{10}$$

$$\pi_{2j} = \beta_{20}$$

$$\pi_{3j} = \beta_{30}$$

$$\pi_{4j} = \beta_{40}$$

Finally, we investigated whether symptom reduction can be predicted by synchrony levels in each group (in the depressive subsample, the BSI subscale “depression” was used and in the anxiety sample, the BSI subscale anxiety was used). Therefore, BSI post scores were used as the criterion and nonverbal synchrony (measured at the beginning of therapy) was used as the predictor, while controlling for BSI pre scores and movement quantity (measured at the beginning of therapy) in our random-intercept models.

All analyses were performed using SPSS Statistics 24 (IBM, 2016).

6.4 Results

Differences of Movement Quantity in Depression and Anxiety

We first performed an intercept-only model to test for level 2 (therapist) effects on patient movement quantity at the beginning of treatment. Level 1 (patient) variance was .01, level 2 variance was .03, resulting in an ICC of .18, meaning that 18 % of variance of movement quantity is due to differences between therapists. As the therapist effect was significant for movement quantity (Wald Z $p = .04$), we controlled for it in further analyses.

We further investigated patient diagnosis (depression vs. anxiety) and the time of assessment (beginning vs. end of treatment) as predictors of patient and therapist movement quantity. Raw scores of movement quantity are displayed in Table 2. It was found that patient movement quantity was significantly predicted by both the time of assessment [$F(1,152.70) = 8.53$, $p < .01$] and diagnosis [$F(1,162.64) = 4.06$, $p < .05$], see Figure 2, whereas the inclusion of the interaction term did not significantly improve model fit ($p = .67$). The model revealed that depressive patients move less than anxious patients and movement quantity decreases over the course of therapy, see Table 3. Furthermore, we found that patient diagnosis could not predict therapist movement quantity [$F(1,154.94) = .07$, $p = .80$], meaning that the amount of therapist movement was independent of patient diagnosis. Similar to the patient movement pattern, a decrease from the beginning to the end of therapy was also found in therapist movement quantity [$F(1,147.55) = 12.22$, $p < .001$].

Differences of Nonverbal Synchrony in Depression and Anxiety

We first performed an intercept-only model to test for level 2 (therapist) effects on cNS at the beginning of treatment. Level 1 (patient) variance was 5.82, level 2 variance was .10, resulting in an ICC of .02, meaning that 2 % of variance of cNS is due to differences between therapists. Although the therapist effect remained nonsignificant (Wald Z $p = .85$), we continued to control for it in further analyses. Next, we tested sex as a possible confounding variable on nonverbal synchrony and found that neither patient [F(1,81.33) = .04, p = .84], nor therapist gender [F(1,87) = 2.64, p = .10], nor dyad type (same- vs. opposite-sex) [F(1,81.33) = .37, p = .55] had an effect on the level of nonverbal synchrony. Furthermore, we compared both groups with respect to systematic differences in treatment length. There were no differences between the depression and anxiety groups with regard to the amount of sessions that lapsed between the pre and post measures ($M_{depr} = 33.87$, SD = 15.68; $M_{anx} = 27.60$, SD = 14.49, $t_{(78)} = -1.58$, p = .12). Thus, we did not control for “treatment length” in further analyses.

As patient movement quantity was significantly predicted by the diagnosis, we included it alongside diagnosis and time of assessment as a predictor in our two-level model with cNS as the criterion (for raw scores of nonverbal synchrony see Table 2). Multilevel modelling showed a significant effect of the inclusion of these predictors on cNS ($\chi^2_{change} = 24.73$, $df_{change} = 4$, $p < .01$). It was found that the interaction between diagnosis and time of assessment [F(1,146.75) = 7.15, p < .01] was a significant predictor of cNS, even when controlling for patient movement quantity, which was no significant predictor of cNS itself

[F(1,133.95) = 1.83, p = .18], see Table 3. Furthermore, diagnosis [F(1,147.82) = 7.45, p < .01] was a significant predictor for cNS at the beginning of therapy and time of assessment [F(1,147.71) = 4.20, p = .04] predicted cNS significantly in patients with anxiety disorders. In detail, results from simple slopes analysis revealed that dyads with depressive patients had a significantly lower cNS at the beginning of therapy than dyads with anxious patients ($Beta_{diag}$ = –1.35, $t_{(87)}$ = –2.39, *p* = .02), while both groups no longer differed at the end of therapy ($Beta_{diag}$ = .78, $t_{(82)}$ = 1.31, *p* = .19). Furthermore, the significant interaction between diagnosis and time of assessment indicates that dyads with depressive patients increased with regard to nonverbal synchrony over the course of therapy, while dyads with anxious patients decreased (see Figure 3). This can be considered an indication of successful treatment as symptoms were also significantly reduced in the BSI for both diagnostic groups, depression ($Beta_{depr}$ = –.81, $t_{(121)}$ = –6.85, *p* < .001, *d* = 1.23) and anxiety ($Beta_{anxiety}$ = –.47, $t_{(44)}$ = –2.83, *p* = .01, *d* = .92). Furthermore, we investigated whether nonverbal synchrony is predictive of symptom reduction. Accordingly, it was found that nonverbal synchrony at the beginning of therapy was a significant predictor of symptom reduction in depressive patients [F(1,47.38) = 6.17, p = .02], but not in patients with anxiety disorders [F(1,14.55) = .87, p = .37], while controlling for movement quantity respectively. Results reveal that lower levels of nonverbal synchrony in dyads with depressive patients at the beginning of therapy are predictive of greater symptom reduction (Beta= .13).

6.5 Discussion

Nonverbal synchrony has repeatedly been shown to be associated with process factors such as the therapeutic relationship, self-efficacy and therapy outcome (e.g. Paulick et al., 2017; Ramseyer & Tschacher, 2011). While we increasingly understand the processual meaning of nonverbal synchrony in psychotherapy, there is nearly nothing known about the influence of diagnostic factors on this basic form of interpersonal synchronization.

Therefore, the present study sought to fill this gap by examining depression and anxiety as predictors of nonverbal synchrony (while controlling for movement quantity).

In line with our hypothesis, we found that depressive patients move less frequently than anxious patients. This result is consistent with former studies demonstrating that depressed patients move less, show slower gait patterns and an enhanced standing phase while walking (Lemke et al., 2000; Paleacu et al., 2007; Sloman et al., 1982; Sloman et al., 1987; Wendorff et al., 2002), while anxious patients show more trembling and restless movements (Clark & Wells, 1995; Kang et al., 2012). Furthermore, we found a decrease in movement quantity from the beginning to the end of therapy for both diagnostic groups, as well as for the therapists, independent of their patients' diagnosis, suggesting that this decrease of movement quantity over the course of therapy is something generic and not to be considered in dependence of diagnostic categories. In addition, therapist movement quantity did not differ regarding patient diagnosis (depression vs. anxiety), revealing that therapists tended not to adjust their movement quantities to that of their patients.

In line with our hypothesis, dyads with depressive patients had a lower level of nonverbal synchrony at the beginning of therapy than dyads with anxious patients. These results remained even when controlling for patient movement quantity, which was considered a measure of psychomotor retardation/agitation. Furthermore, nonverbal synchrony in dyads with depressive and anxious patients no longer differed at the end of therapy, as nonverbal synchrony increased in depressive patients and decreased in anxious patients. At first glance, these results may be related to a regression to the mean, whereby the applied measurement methods show excellent reliability, reducing the likelihood of regression to the mean being the only explanation for the reported findings. Nevertheless, these findings reveal that synchronization differences between depressive and anxious patients exist beyond psychomotor deviances. Nonverbal synchrony may therefore be considered a process variable, providing additional information beyond the movement pattern of patients or therapists. Especially for depressive patients, it is conceivable that nonverbal synchrony is related to a restricted range of affect, which inhibits the ability to recognize and share feelings. However, receiving empathy from one's dialog partner and also expressing one's own empathy is crucial for emotional contact (Salovey & Mayer, 1990). As improving range of affect is a central focus during the course of therapy (Beck, 1979), it is thinkable that nonverbal synchrony in the patient-therapist dyad increases, as the patient's range of affect and ability to engage in emotional contact improve. In addition to depression, a restricted range of affect is also known in schizophrenia (American Psychiatric Association, 2000). It has already been found that lower nonverbal synchrony in dyads with schizophrenia patients is related to symptom severity, lower social competence, impaired social functioning, and lower self-evaluation of competence, even when controlling for the amount of movement (Kupper et al., 2015).

For anxiety, on the other hand, it is also conceivable that nonverbal synchrony reflects a wide range of affect, as especially anxious patients are known to observe their conversational partners very well. Whereas depressive patients have private self-awareness, meaning that they primarily focus on their own thoughts and feelings, especially patients with social phobia have public self-awareness, meaning that they primarily focus on their effect on others (Mor & Winquist, 2002; Smith & Greenberg, 1981). Furthermore, there is evidence that depressive patients have many thoughts about themselves, especially self-devaluation, whereas patients with anxiety disorders tend to focus more on their surroundings, especially on risks (Beck et al., 1987; Ingram & Smith, 1984). During the course of therapy of many anxiety disorders, it is an aim to enable the patients to get more in contact with their own feelings and needs and therefore to no longer focus so much on external risks and their effect on others (Wells, 2013). In this context, nonverbal synchrony may indeed be considered a nonverbal measure of the patient's attention focus, reflecting his or her ability to flexibly be *in contact* with both the therapist and him or herself, which may be promoted by a healthy range of affect. While treatment of depression may facilitate the patient's ability to let go of an internal attention focus and come in contact with the therapist, treatment of anxiety may reduce an exaggerated attention focus on external cues and allow patients to better perceive their internal experiences.

Furthermore, the treatments of both groups were successful as symptoms reduced significantly between pre and post measures. For depressive patients, a negative relation between nonverbal synchrony and symptom reduction was found as lower levels of synchrony at the beginning of therapy were predictive of greater symptom reduction. Previous research concerning relations between nonverbal synchrony and treatment outcome are heteronomous, with Ramseyer and Tschacher (2011) finding higher levels to be advantage, whereas Paulick et al. (2017) found a medium level of nonverbal synchrony at the beginning of therapy to be predictive of therapeutic success. However, the mentioned studies dealt with diagnosis heterogenic samples and the present results only refer to depressive patients. Further studies are needed to further understand the diagnosis-specific relations between nonverbal synchrony and symptom reduction.

Limitations

One limitation refers to the sample size, which was significantly reduced as a result of the exclusion of comorbidities between anxiety and depression, both belonging to the most common mental disorders and comorbidities being high (e.g., Sartorius et al., 1996). Furthermore, several videos either at the beginning or the end of therapy had to be excluded due to bad video quality, resulting in the inclusion of patients with a video at only one time of assessment. On the other hand, the exclusion of comorbidities and videos with low quality was important to avoid distortion of our data and enable us to compare two highly important diagnostic groups with regard to their nonverbal synchrony.

Another limitation is related to the automatic measurement of nonverbal synchrony. In this field, there are different approaches to measure simultaneous movements and to calculate nonverbal synchrony (Altmann, 2011; Grammer et al., 1999; Ramseyer & Tschacher, 2011). It has already been shown that varying methods find different levels of nonverbal synchrony, which, on the one hand, poses a challenge regarding comparability and generalizability. For instance, one difference refers to the pre-processing steps (inter alia, including the smoothing procedure with a moving average), which might influence the level of synchrony. Thielemann et al. (2017) give an overview of different methods for calculating nonverbal synchrony, suggesting that smoothing with a moving average might reduce the level of nonverbal synchrony.

Furthermore, the absolute values of nonverbal synchrony are difficult to interpret and, to date, only comparative statements can be made (e.g., Paulick et al., 2017; Ramseyer & Tschacher, 2011). In that sense, questions may be raised regarding the presented result that anxious patients reach nearly the same levels of nonverbal synchrony at the end of therapy as depressive patients at the beginning. To date, it is not clear, which levels of nonverbal synchrony are beneficial for certain diagnostic groups. The present study attempts to provide an initial sense of these relations. However, comparisons with other studies reveal that values are comparable to, for instance, mean values for nonverbal synchrony and pseudosynchrony reported by Ramseyer and Tschacher (2011) ($M_{synchrony}$ = .113, SD = .017; $M_{pseudosynchrony}$ = .106, SD = .010), values reported by Paulick et al. (2017) ($M_{synchrony}$ = .15, SD = .05; $M_{pseudosynchrony}$ = .09, SD = .01) and values reported in the present study (see Table 2). Mean values for corrected nonverbal synchrony (cNS) have only been reported by Paulick et al. (2017) so far and ranged between 2.5 – 2.9 at the beginning of therapy for patients with later drop-out, between 3.4 – 3.8 for improved patients and 3.9 – 5 for patients with later non-improvement. Thus, the reported values in the present study seem comparable. Future studies should compare levels of nonverbal synchrony in patients and healthy persons and investigate the effects of experimental manipulation (very high/low synchrony) to create a context.

Conclusion and Future Directions

Beyond these limitations, this study was the first to investigate depression and anxiety as predictors of nonverbal synchrony, while controlling for movement quantity. Whereas associations between nonverbal synchrony and process variables such as the therapeutic relationship, self-efficacy and therapeutic outcome have repeatedly been shown, diagnostic predictors of nonverbal synchrony have widely been neglected so far. Studies like ours provide important information about nonverbal aspects of mental disorders, as this nonverbal focus has long been disregarded compared to research on verbal behavior. Meanwhile, in the context of growing research interest in embodiment, nonverbal aspects are increasingly shifting into the spotlight (Fuchs & Schlimme, 2009; Michalak et al., 2009; Tschacher & Pfammatter, 2016).

In future research, it may be interesting to further investigate diagnosis-specific patterns of nonverbal synchrony. In future studies replicating our findings, the sample size (assuming the reported effect of $d=.57$ between depression and anxiety regarding cNS at the beginning of therapy, $\alpha=.05$, $1-\beta=.80$) should include at least a total sample of $N=78$ patients (with $n=39$ in each diagnostic group). Furthermore, especially for patients with social phobia or avoidant personality disorder, it may be interesting to examine the assumed association between submissiveness and higher levels of nonverbal synchrony. It may especially be of interest to further investigate the idea of a relation between range of affect and nonverbal synchrony as this may provide nonverbal access to phenomena such as the patient's ability to be in emotional contact with him or herself and the therapist, which can hardly be assessed consciously, but are important to understand psychotherapeutic processes.

Furthermore, the investigation of associations between nonverbal synchrony and typical change patterns of psychotherapy patients, such as early response, may be a valuable addition to prediction models of therapy outcome (Lutz et al., 2009). From this perspective, nonverbal synchrony could prospectively be a promising tool to be automatically measured and fed back to therapists in training.

6.6 Tables and Figures

Table 1

Sample characteristics

Variable	Depression (N=68)	Anxiety (N=25)
Patient age (years)	M=37.46 (20-68)	M=34.96 (20-63)
Patient sex (female)	55.9%	48%
Therapist sex (female)	52.9%	64%
Dyad type same/opposite sex (same)	58.8%	44%
Therapy duration (sessions)	M=41.6 (16-82)	M=34.12 (16-64)
Session number "beginning of therapy"	M=4.7 (3-12)	M=4.2 (3-7)
Session number "end of therapy"	M=38.7 (15-83)	M=31.5 (13-62)
Number of sessions "beginning of therapy"	N=65	N=24
Number of sessions "end of therapy"	N=63	N=21
Drop-out frequency	14.7%	8%
Drop-out after session number	M=26.4 (16-56)	M=30.5 (17-44)
Comorbidity		
Patients with one diagnosis	26.5%	56%
Patients with two or more comorbid diagnoses	36.8%	20%
Marital status		
Single	55.9%	52%
Married	26.5%	40%
Divorced/separated	16.2%	4%
Widowed	1.5%	-
Education		
Lower secondary education certificate	25%	32%
Intermediate secondary education certificate	26.5%	12%
General qualification for university entrance	47.1%	48%
Still in school	-	4%
No school-leaving certificate	1.5%	-
Employability		
Not working because of sick leave	20.6%	8%

Note: Marital status was available for N = 92 patients (98.9 %).

Table 2

Mean values (standard deviations) of patient and therapist movement quantity, NS, pseudosynchrony and cNS for depression and anxiety

Movement measures	Time of assessment	M (SD) Depression (N=68)	M (SD) Anxiety (N=25)	Effect size (Cohens d)
Patient movement quantity	Pre	.80 (.17)	.86 (.12)	.38 [-.08; .84]
	Post	.72 (.22)	.81 (.13)	.45 [-.01; .91]
	Pre-post effect size (d)	.37 [.08; .76]	.33 [-.02; .91]	
Therapist movement quantity	Pre	.71 (.19)	.71 (.17)	.00 [-.46; .46]
	Post	.63 (.23)	.62 (.20)	.05 [-.50; .41]
	Pre-post effect size (d)	.45 [.16; .85]	.68 [.17; 1.31]	
NS	Pre	.14 (.04)	.17 (.06)	.65 [.18; 1.12]
	Post	.15 (.06)	.12 (.04)	.54 [.08; 1.01]
	Pre-post effect size (d)	.15 [-.15; .52]	.69 [.25; .93]	
Pseudo-synchrony	Pre	.09 (.01)	.10 (.01)	1.00 [.52; 1.48]
	Post	.09 (.02)	.08 (.02)	.50 [.04; .96]
	Pre-post effect size (d)	.00 [-.34; .34]	.75 [.82; 1.55]	
cNS	Pre	3.13 (2.16)	4.48 (2.86)	.57 [.11; 1.04]
	Post	3.75 (2.47)	2.96 (2.04)	.33 [-.13; .80]
	Pre-post effect size (d)	.19 [-.13; .54]	.45 [.17; .95]	

Note: NS = nonverbal synchrony, cNS = corrected nonverbal synchrony; effect sizes were calculated using pooled standard deviations; 95% confidence intervals for each effect size measure are given in [ ]

Table 3

Fixed effects for random intercept models examining the relations between the time of assessment, diagnosis, patient movement quantity and cNS

Fixed effects	Dependent variable	Parameter estimates	Std. error	t value	p	AIC
Intercept	Patient	.94	.05	19.96	.00	-97.60
Time of assessment	movement	-.07	.03	-2.92	.00	
Diagnosis	quantity	-.06	.03	-2.02	<.05	
Intercept	cNS	4.67	1.45	3.22	.00	773.88
Time of assessment		-1.44	.70	-2.05	.04	
Diagnosis		-3.46	1.27	-2.73	<.01	
Time of assessment x diagnosis		2.19	.82	2.67	<.01	
Patient movement quantity		1.42	1.05	1.35	.18	

Note: cNS = corrected nonverbal synchrony

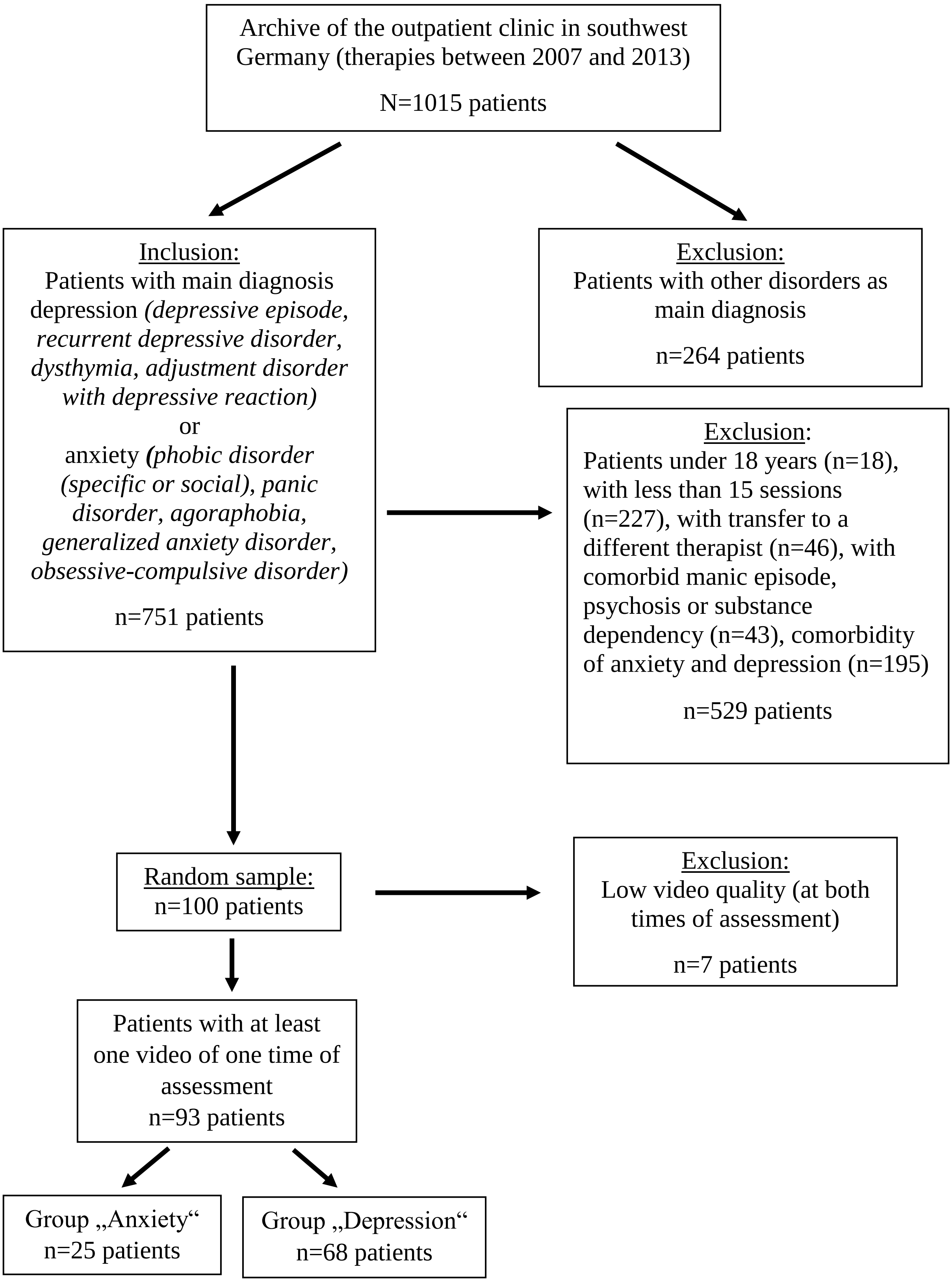

Figure 1. Flow chart

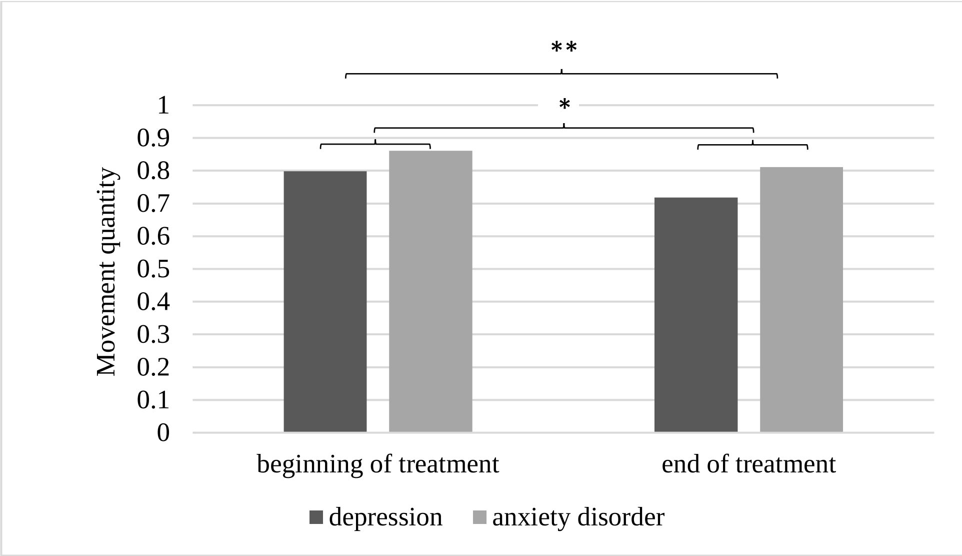

Figure 2. Main effects of diagnosis (depression vs. anxiety) and time of assessment on movement quantity (significant differences in mixed models are marked by p<.05*, p<.01**).

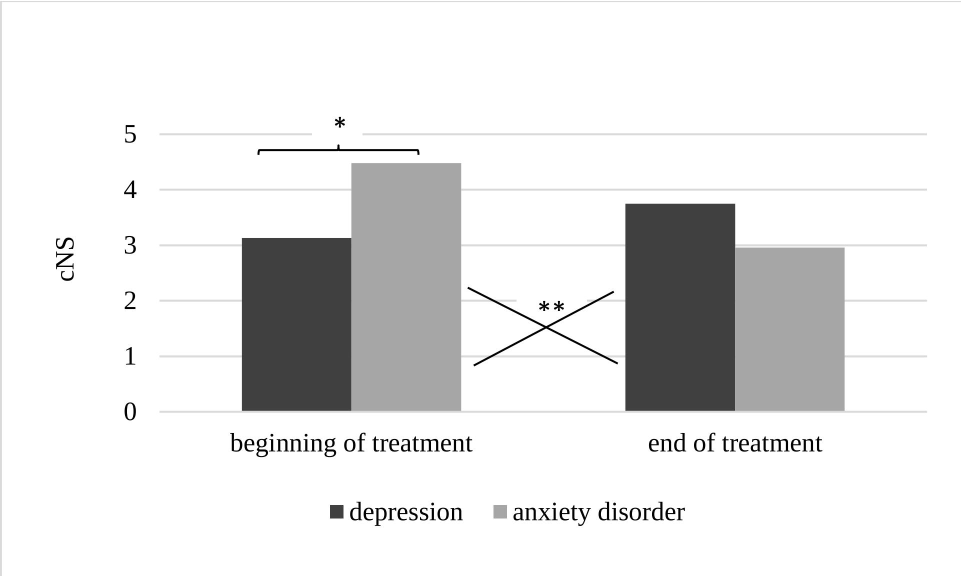

Figure 3. Interaction effect of diagnosis and time of assessment on nonverbal synchrony and results from simple slope analysis (when controlling for movement quantity). cNS = corrected nonverbal synchrony (significant differences in mixed models are marked by $p<.05$*, $p<.01$**).

6.7 Study II: References

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7 Study III: Nonverbal Synchrony in Social Phobia: A New Approach Linking Early Response and Treatment Outcome

Paulick, J., Rubel, J., Thielemann, D., Deisenhofer, A.-K., Schwartz, B., Terhürne, P., Boyle, K., Altmann, U., Strauß, B., & Lutz, W. Nonverbal Synchrony in Social Phobia: A New Approach Linking Early Response and Treatment Outcome. Submitted to *Journal of Counseling Psychology,* November 13th, 2017

7.1 Abstract

Background: The likelihood of positive outcome in psychotherapy is increased when patients experience early response. Until now, linking mechanisms remain widely unknown. One influencing factor may be nonverbal synchrony, which is considered a measure of accordance or *being in contact* and has been shown to be predictive of treatment outcome. Especially patients with social phobia show deficits in their ability to make contact. In this study, we investigated associations between nonverbal synchrony, early response and outcome in patients with social phobia.

Methods: The sample consisted of 111 patients with social phobia who were treated with integrative cognitive-behavioral therapy. Videotaped sessions (N=346) were analyzed using Motion Energy Analysis (MEA), providing a value for nonverbal synchrony. Early response was calculated via reliable change until session seven. Using multilevel modelling, we first investigated associations between early response, time of assessment, and nonverbal synchrony. Second, we examined the effects of early response and nonverbal synchrony on outcome.

Results: We found no effect of early response on nonverbal synchrony, but a general decrease of nonverbal synchrony over the course of therapy. Furthermore, we found an interaction effect between early response and nonverbal synchrony, revealing a greater effect of early response on outcome for patients with higher nonverbal synchrony in early stages of psychotherapy. Conclusions: Nonverbal synchrony seems to moderate the effect of early response on outcome. Limitations of the measurement of early response and nonverbal synchrony as well as possible applications in routine care are discussed.

Keywords: social phobia, early response, nonverbal synchrony, outcome, MEA

Public significance statement: This study suggests that nonverbal synchrony between patients and therapists moderates the effect of early symptom reduction on treatment outcome. In the future, the feedback of nonverbal synchrony may be used to improve therapy outcomes.

7.2 Introduction

In recent years, research interest in the investigation of early change patterns in psychotherapy has grown. Early response, defined as symptom reduction in early stages of psychotherapy, has been shown to be predictive of treatment outcome at termination and follow-up (Haas, Hill, Lambert, & Morrell, 2002; Lutz, Stulz, & Köck, 2009; Nordberg, Castonguay, Fisher, Boswell, & Kraus, 2014). Its predictive value has been confirmed in samples with different age groups (e.g., Gunlicks-Stoessel & Mufson, 2011), psychological and pharmacological treatments (e.g., Hofmann, Schulz, Meuret, Moscovitch, & Suvak, 2006; Uher et al., 2010; van Calker et al., 2009), in different diagnostic groups (e.g., Aderka, Nickerson, Bøe, & Hofmann, 2012; Gunlicks-Stoessel & Mufson, 2011; Lutz et al., 2014), and for diverse instruments used to measure early response (e.g. Henkel et al., 2009; Leucht et al., 2007). Whereas early response has repeatedly been shown to be a powerful predictor of therapy outcome, little is known about the mechanisms linking early improvements to positive treatment outcomes (Stulz, Lutz, Leach, Lucock, & Barkham, 2007). It is conceivable that very early responses to psychotherapy go along with insight or important realizations (Lambert, 2007) and lead to an improvement of the therapeutic relationship

(Tang & DeRubeis, 1999). Beyond that, there is a lack of knowledge of factors that have an influence on the relation between early response and successful therapy outcome.

A construct that may affect the relation between early response and outcome is *nonverbal synchrony*, defined as movement coordination between interacting persons (Condon & Ogston, 1966). Its origins go back to research in developmental and social psychology, showing associations with higher relationship quality (e.g., Chartrand & Bargh, 1999; Grammer, Honda, Juette, & Schmitt, 1999), resonance/rapport (e.g., Bernieri, Davis, Rosenthal, & Knee, 1994), interaction in positive situations (e.g., Altmann, 2011) and involvement (e.g., Katsumata, Ogawa, & Komori, 2009). In mother-neonate interactions, it has been connected to healthy child development (e.g. Lindsey, Mize, & Pettit, 1997). Whereas former studies investigating nonverbal synchrony used human ratings to analyze body movements, newer studies make use of more economic automatic video analysis systems, finding comparable results (e.g., Altmann, 2013; Tschacher, Rees, & Ramseyer, 2014).

In psychotherapy research, nonverbal synchrony has been shown to be associated with the therapeutic relationship (e.g., Ramseyer & Tschacher, 2011) and patient self-efficacy (Koole & Tschacher, 2016). It has therefore been considered a nonverbal measure of the patient's ability to flexibly be *in contact* with both the therapist and him or herself (Paulick et al., 2017). Furthermore, a predictive value for therapeutic outcome has been repeatedly confirmed (e.g., Paulick et al., in press; Ramseyer & Tschacher, 2011). However, studies on the influence of patient diagnosis on nonverbal synchrony are lacking. The very few studies that have been conducted to date have confirmed that the diagnosis has an important impact on nonverbal synchrony. For schizophrenia, a lower level of nonverbal synchrony was indicative of more negative symptoms (Galbusera et al., 2016), lower social competence, impaired social functioning and a lower patient self-evaluation of competence (Kupper et al., 2015). Paulick et al. (2017) compared patients with depression and anxiety and found a lower level of nonverbal synchrony in dyads with depressive patients. Furthermore, an increase of nonverbal synchrony for depression and a decrease of nonverbal synchrony for anxiety was found over the course of therapy. Apart from that, more studies investigating the effects of other diagnoses on nonverbal synchrony are necessary - especially concerning mental disorders whose central criteria are interaction problems, such as social phobia.

Social phobia is among the most common mental disorders (Kessler, Petukhova, Sampson, Zaslavsky, & Wittchen, 2012). Patients are characterized by a fear of negative assessment by others in social situations, which are consequently often avoided, leading to a subsequent restriction of their lifestyle (American Psychiatric Association, 2000). Their perception is often selective for negative aspects of their own appearance and the reaction of others to it (Mor & Winquist, 2002). Patients with social phobia perceive themselves as being less skilled in social interactions (Spence, Donovan, & Brechman-Toussaint, 1999) and their conversational partners describe their behaviour as abnormal and irritating (Waxer, 1977). Their safety behaviour, which is often perceived as distant/impersonal and arrogant/denying, can be traced back to a blocked perception of social cues and high self-attention in social interactions (Rapee, 1995; Stravynski, Kyparissis, Amado, Hoffmann, & DiBartolo, 2010). Furthermore, they are characterized by submissive and over-adapting behavior, which is aimed to be reduced in psychotherapy (Wells, 2013).

Besides these characteristics, patients with social phobia often also display typical nonverbal behaviours such as the avoidance of eye contact (Farabee, Ramsey, & Cole, 1993), rare spontaneous smiling (Del-Monte et al., 2013), fretful movements (Kang, Rizzo, & Gratch, 2012) and self-manipulative behaviour, such as playing with one’s hair (Baker & Edelmann, 2002). Overall, the literature shows that patients with social phobia behave less naturally and more submissively, which is observable in their verbal and nonverbal behaviour.

The aim of this study is to investigate associations between nonverbal synchrony, early response and treatment outcome in psychotherapy of patients with social phobia. These patients are characterized by difficulties establishing contact with other people, which is also expressed in specific nonverbal patterns we assume can be captured by nonverbal synchrony. First, we test whether dyads with early responders significantly differ from dyads with initial non-responders with regard to level of nonverbal synchrony - at the beginning of therapy as well as later on. Second, in accordance with Paulick et al. (2017), we hypothesize nonverbal synchrony in patients with social phobia will decrease during the course of therapy. Third, we explore whether nonverbal synchrony interacts with early response with regard to treatment outcome. If this is the case, we will investigate whether nonverbal synchrony moderates the relation between early response and treatment outcome (even when controlling for the therapeutic relationship, as nonverbal synchrony is considered to go beyond survey measures of the therapeutic relationship).

7.3 Methods

Participants and Treatment

The analyses were based on a sample comprised of 111 patients with social phobia (main or second diagnosis) treated by 70 therapists between 2008 and 2016 at an outpatient clinic in southwest Germany. Patients included in the analysis received at least seven sessions of individual treatment with a mean treatment length of 42.7 sessions (*SD* = 18.8) and a dropout rate of 21.6%. We used 346 videotaped sessions from four times of assessment (session 3, session 8, session 20, session 30) for the current analyses. Patients were over 15 years of age (*M* = 33.8, *SD* = 11.6) and the majority was male (55.9%). Sessions were selected by checking suitability for video analysis (see below). Therapists (84.7% female, mean age: 31.0 years) treated between one and four patients (*M* = 1.58 patients). For sample characteristics, see Table 1.

All therapies in this study had an integrative cognitive-behavioral therapy (CBT) focus, including interpersonal and emotion-focused elements (Castonguay, Eubanks, Goldfried, Muran, & Lutz, 2015; Lutz, Schiefele, Wucherpfennig, Rubel, & Stulz, 2016). The CBT program was comprised of psycho-education, cognitive restructuring, relaxation training elements and in sensu as well as in vivo situational exposure, whereas therapists individually adapted their approach depending on patient characteristics. All therapists in this study were enrolled in a 3-year (full-time) or 5-year (part-time) postgraduate training program with a CBT focus. They had received at least one year of training before beginning to see patients and were supervised by a senior therapist every 4th session. Research data was routinely collected via a range of instruments and therapy sessions were consistently videotaped (with the informed consent of all patients with regard to the use of their data and videos for research). Therapists were provided with psychometric feedback on patient symptomatic change after each session. This study was approved by the ethical board.

Patients were diagnosed based on the Structured Clinical Interview for Axis I DSM-IV Disorders (SCID-I; Wittchen, Wunderlich, Gruschwitz, & Zaudig, 1997). The interviews were conducted by intensively trained independent clinicians before actual therapy began. Subsequently, the videotaped interviews and diagnoses were discussed in expert consensus teams comprised of four senior clinicians. Final diagnoses were determined by consensual agreement of at least 75% of the team members. Patients with social phobia as the main or second diagnosis were included in the study. Patients were excluded from the study if they had a comorbid substance dependency or psychosis (as both disorders may have severe effects on nonverbal behavior, possibly distorting the data) or if they were transferred to a different therapist during the course of therapy.

Video Selection

Videos were selected at four times of assessment: session 3 (“s3”, $N = 111$), session 8 (“s8”, $N = 111$), session 20 (“s20”, $N = 70$) and session 30 (“s30”, $N = 54$). These assessments covered a "short-term treatment", the minimal number of sessions that can be applied for from the health insurance company. If the video of the preferred session was not suitable for video analysis (e.g., due to bad quality), a video maximum +/- 1 session was subsequently selected. The selection of times of assessment was based on general suitability for video analysis (e.g., routine filling in of questionnaires in certain sessions, patient transfer to final therapist only after session two). After prescreening, videos were excluded according to the following criteria: a) low video quality (e.g., image errors, heavy lighting changes, reflective clothing), b) movements of one person reached into the split screen of the other and c) patient or therapist left their seating place during the first 15 minutes of the relevant video sequence (their movements could no longer be analyzed, as they had moved out of the camera's focus). This selection process led to a total of 346 included videos, which were used for further analyses.

Furthermore, we only analyzed the first 15 minutes of each therapy session, because the interaction was frequently interrupted by the use of white boards or roleplays (where patient and therapist left their seating places) later in the session. Former studies have demonstrated that nonverbal synchrony during the first 15 minutes of the therapy session and the entire 50 minutes of the session is highly correlated and above $r = .80$ (Paulick et al., in press; Ramseyer & Tschacher, 2011).

Measurement of Nonverbal Behaviour via Motion Energy Analysis (MEA)

All therapy sessions were recorded using two cameras joined into a split-screen image. Video quality was ensured through a static camera position, stable light conditions and digitized film material. Nonverbal behavior was measured via an objective and automated video analysis algorithm called Motion Energy Analysis (MEA), implemented in the statistics software MATLAB (2012). Before MEA can be applied, some pre-processing steps are necessary. First, videos were converted into .avi format and scaled to a size of 640:480 (with a frame rate of 25 frames/sec, 2000 bit per second) using the Any Video

Converter 3.0 (AVC, 2009). Next, videos were cut to a length of 15 minutes. In line with former studies using MEA, we defined the upper body beginning at the seat of the chair as a specific region of interest (ROI), as the patients' and therapists' legs were often covered by the table or one person's feet were visible on the others person's split screen. Furthermore, two background ROI (10x10 pixels) were drawn in the upper half of each split-screen to measure noise (e.g. due to light changes in the therapy room), for which we corrected later (Altmann, 2013).

After these pre-processing steps, MEA was applied and computed the grey scale pixel differences between the sequential video frames for each interacting person according to the definition of motion energy (Grammer et al., 1999). A threshold for movement detection was empirically determined and set to a pixel change of 12 to automatically exclude minimal light changes or video noise. Afterwards, time series were standardized to the size of each ROI (divided by the number of pixels in each ROI and multiplied by 100) to control for different ROI sizes and avoid over-/underestimation of movements. This resulted in motion energy values being equivalent to percent values as a value of 100 represented an activation of 100% of the ROI. Subsequently, we corrected the time series for coding and video image errors as follows: If the background ROI had a value higher than five, the associated sections in the respective time series were replaced by missing values. Furthermore, if the difference between three consecutive pixels was higher than 15 (representing an increase of 15% from one frame to the next, followed by an appropriate decrease, or vice versa), this leap was identified as an image error and the corresponding values were coded as missing. This procedure was based on a data-driven analysis to find a cut-off for movements that can be produced by humans. All missings were subsequently linearly interpolated by neighboring values and complemented by noise to avoid artificial synchronization, which may occur if both time series are interpolated at the same place and the neighbors are very similar. If more than eight frames in a row were set to missing, the analysis stopped and the videos were excluded. Finally, a moving median of five was applied to each time series to smooth small signal irregularities.

Quantification of Nonverbal Synchrony

Nonverbal synchrony, more precisely movement synchrony, was measured using an automated algorithm employing windowed cross-lagged correlation (WCLC) implemented by Altmann (2011, 2013). Before WCLC was run, the time series of both patient and therapist were logarithm transformed to account for different peak heights. Afterwards, WCLC was applied as follows. First, correlations between segments (bandwidth of 125 frames = 5 seconds) of the time series of the patient and therapist were calculated. These segments were rolled over the time series in steps of one frame (= 0.04 seconds). To account for differing time lags between synchronous movements of patient and therapist, the analysis was performed with one of the time series lagged by up to 125 frames (= 5 seconds). Correlations were tested against zero using a parametric test. If a correlation failed to reach significance, it was set to zero to account for randomly occurring synchrony. Afterwards, correlation coefficients were squared to highlight the distinctions between low and high correlation indices and to produce solely positive values. To identify intervals with meaningful synchronization, a peak-picking algorithm was applied (for details, see Altmann, 2011, 2013; Thielemann et al. 2017b). Synchronization intervals were then filtered when they lasted more than 0.4 seconds (Altmann, 2013) and their average R^2 value was higher than 0.25. As shown in a validation study, intervals with lower R^2 values may reflect randomly identified synchrony (Thielemann et al., 2017a). The global synchrony score was calculated by dividing the time with significant synchronization by the total duration of the sequence and then multiplying it by 100. Thus, the resulting value represents the percentage of synchronous movements (simultaneous as well as time-lagged) of patient and therapist.

Instruments

Hopkins-Symptom-Checklist-11 (HSCL-11). The HSCL-11 (Lutz, Tholen, Schürch, & Berking, 2006) is a self-report inventory that assesses symptom distress. It is an 11-item short-form of the Symptom-Check-List-90-Revised (SCL-90-R; Derogatis, 1975). The items are answered on a 4-point Likert scale ranging from 1 ('not at all') to 4 ('extremely'). The mean of the 11 items represents the patients' global level of symptom distress and is highly correlated with the General Symptom Index (GSI) of the Brief Symptom Inventory (BSI; $r = 0.91$). In this study, we used the mean scores at sessions 1 and 7 to identify early response.

Penn Helping Alliance Questionnaire (HAQ). The HAQ (Alexander & Luborsky, 1986; German translation by Bassler, Potratz, & Krauthauser, 1995) is an 11-item self-report questionnaire that assesses the therapeutic relationship and process. It has a 6-point Likert scale ranging from 1 ('strongly disagree') to 6 ('strongly agree') and two subscales 'satisfaction with therapeutic relationship' and 'satisfaction with therapeutic success'. Internal consistency reported in the literature is high ($\alpha = .89$; Bassler, Potratz, & Krauthauser, 1995). The therapeutic relationship was assessed from the patient's perspective after sessions 4, 9, 19, 29 in temporal proximity to the four measures of nonverbal synchrony. The mean score of the subscale 'therapeutic relationship' was used as a covariate in our model examining the relation between early response, nonverbal synchrony and outcome.

Brief Symptom Inventory (BSI). This 53-item self-report inventory is the brief version of the Symptom Check-List-90-Revised (SCL-90-R; Derogatis, 1975; German translation by Franke, 2000) and assesses psychological and physical symptoms within the last week. Items are answered on a 5-point Likert scale ranging from 0 ('not at all') to 4 ('extremely'). It has excellent internal consistency ($\alpha = .92$) and retest-reliability ($r_{tt} = .90$) (Franke, 2000). In this study, the subscale 'interpersonal sensitivity' was used as an outcome measure and computed by averaging the corresponding BSI items at pre- and post-treatment.

Quantification of Early Response

There are different approaches to defining early response with regard to the period of time, the instruments and the statistical analysis (for an overview, see Lambert, 2005; Rubel, et al., 2015). In this study, early response was defined and calculated based on the concept of reliable change (e.g., Jacobson & Truax, 1991; Lutz, Stulz, Martinovich, Leon, & Saunders, 2009), a relatively simple and frequently applied technique (Rubel et al., 2015; Wise, 2004). Therefore, we used symptomatic change between the first and seventh therapy session on the HSCL-11 (Van et al., 2008). To classify patients according to this concept, the reliable change index (RCI) of an instrument is required. Reliable change is achieved when the difference between two times of assessment significantly exceeds the instrument's measurement error. For this classification, we used the HSCL's RCI = .43 (SD = .79, α = .85; Lutz, Tholen, Schürch, & Berking, 2006).[2] Subsequently, patients were classified as *early responders* if the RCI condition was fulfilled (meaning that the difference between session 1 and 7 was higher than the RCI) and as *initial non-responders* if the RCI condition was not fulfilled. This resulted in a total number of N = 38 early responders and N = 73 initial non-responders, whereas the groups did not significantly differ on any of the demographic variables (for descriptive statistics, see Table 1).

Data Analytic Strategy

As patients were nested within therapists, multilevel models were employed, which are recommended as the method of choice for hierarchical data (Hox, 2010; Lutz et al., 2007). We calculated two-level models with patients on level 1 and therapists on level 2 (e.g., Schiefele et al., 2016). To test for level 2 (therapist) differences in nonverbal synchrony and outcome, we performed random intercept models. Therapist effects are defined as the

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[2] All RCIs were calculated following Jacobson & Truax (1991):

$$RC_{index} = \sqrt{(2*(sd*\sqrt{1-r_{xx}})^2)} * 1,96$$

where sd is the standard deviation and r_{xx} is the reliability (internal consistency) of each instrument.

intraclass correlation (ICC), which is calculated by dividing the level 2 variance through the total variance (Hox, 2010). However, the interpretation of level 2 variance depends on the sample size. According to Schiefele et al. (2016), the present sample is too small to interpret the ICC with regard to therapist effects. Nevertheless, as our study focuses on level 1, it is adjusted for level 2 effects by applying multilevel models.

First, we investigated group differences between early responders and initial non-responders with regard to nonverbal synchrony measured at s3. Therefore, we used early response (0 'initial non-responder', 1 'early responder') as the predictor and nonverbal $synchrony_{s3}$ as the criterion in a random intercept model:

Level 1: $nonverbal\_synchrony_{s3ij} = \pi_{0j} + \pi_{1j} * early\_response_{ij} + e_{ij}$

Level 2: $\pi_{0j} = \beta_{00} + r_{0j}$

$\pi_{1j} = \beta_{10}$

Second, we investigated the associations between early response, time of assessment and nonverbal synchrony. Therefore, we included early response (0 'initial non-responder', 1 'early responder'), the four times of assessment as dummy coded variables ('s8', 's20' and 's30' with 's3' as the reference category) and the interaction terms between early response and s8, s20 and s30 as predictors and nonverbal synchrony as the criterion in a random-intercept model:

Level 1: $nonverbal\_synchrony_{ij} = \pi_{0j} + \pi_{1j} * early\_response_{ij} + \pi_{2j} * s8_{ij} + \pi_{3j} * early\_response_{ij} * s8_{ij} + \pi_{4j} * s20_{ij} + \pi_{5j} * early\_response_{ij} * s2_{ij} + \pi_{6j} * s30_{ij} + \pi_{7j} * early\_response_{ij} * s30_{ij} + e_{ij}$

Level 2: $\pi_{0j} = \beta_{00} + r_{0j}$

$\pi_{1j} = \beta_{10}$

$\pi_{2j} = \beta_{20}$

$\pi_{3j} = \beta_{30}$

$\pi_{4j} = \beta_{40}$

$\pi_{5j} = \beta_{50}$

$\pi_{6j} = \beta_{60}$

$\pi_{7j} = \beta_{70}$

Third, we examined the associations between early response (0 'initial non-responder', 1 'early responder') and outcome (measured by BSI_{int} change scores) as follows:

Level 1: $BSI_{int}\_change_{ij} = \pi_{0j} + \pi_{1j} * early\_response_{ij} + e_{ij}$

Level 2: $\pi_{0j}=\beta_{00} + r_{0j}$

$\pi_{1j} = \beta_{10}$

Fourth, we included early response (0 'initial non-responder', 1 'early responder'), centered values of nonverbal synchrony (measured at s3, s8, s20, s30), their interaction terms and centered values of the therapeutic relationship (measured with the HAQ in temporal proximity to each measure of nonverbal synchrony) as predictors and BSI_{int} change scores as the criterion in random-intercept models. The generic formula, which we applied to all four measures of nonverbal synchrony, is presented below:

Level 1: $BSI_{int}\_change_{ij} = \pi_{0j} + \pi_{1j} * early\_response_{ij} + \pi_{2j} * nonverbal\_synchrony_{ij} + \pi_{3j} * early\_response_{ij} * nonverbal\_synchrony_{ij} + \pi_{4j} * therapeutic\_relationship_{ij} + e_{ij}$

Level 2: $\pi_{0j}=\beta_{00} + r_{0j}$

$\pi_{1j} = \beta_{10}$

$\pi_{2j} = \beta_{20}$

$\pi_{3j} = \beta_{30}$

$\pi_{4j} = \beta_{40}$

All analyses were performed using SPSS Statistics 24 (IBM, 2016).

7.4 Results

Associations between Early Response and Nonverbal Synchrony

First, we investigated group differences between early responders and initial non-responders with regard to nonverbal synchrony measured at the beginning of therapy. The groups did not differ with regard to nonverbal synchrony measured at s3 [$F(1,109) = .14$, $p = .71$].

Next, we investigated the effects of early response and time of assessment on nonverbal synchrony. Therefore, we included early response, time of assessment (‘s8’, ‘s20’ and ‘s30’ with ‘s3’ as the reference category) and the interaction terms between early response and all times of assessment as predictors and nonverbal synchrony as the criterion in our random-intercept models. It was found that s20 [$F(1,278.08) = 7.09$, $p < .01$] and s30 [$F(1,281.82) = 13.07$, $p < .001$] significantly predicted nonverbal synchrony, revealing a general decrease of nonverbal synchrony over the course of therapy (Figure 1). However, s8 [$F(1,259.76) = 2.55$, $p = .11$], early response [$F(1, 337.79) = .01$, $p = .93$] and the interaction terms between early response and s8 [$F(1,259.76) = .09$, $p = .77$], between early response and s20 [$F(1,275.63) = .05$, $p = .82$] and between early response and s30 [$F(1,282.66) = .16$, $p = .69$] had no predictive value, see Table 2.

Interaction Effects between Early Response and Nonverbal Synchrony on Outcome

Furthermore, we investigated the effects of early response and nonverbal synchrony on outcome measured by BSI_{int} change scores. Performing multilevel modelling, we first used early response as the predictor and BSI_{int} change scores as the criterion in our random-intercept model. Early response was a significant predictor of outcome [$F(1,76) = 8.13$, $p < .01$], revealing a better outcome for early responders (Table 3).

Next, we included early response, nonverbal synchrony (in s3, s8, s20, s30) and their interaction terms as predictors and BSI_{int} change scores as the criterion in our random-intercept models (while controlling for the therapeutic relationship, each measured in temporal proximity to the measure of nonverbal synchrony). Our first multilevel model showed that early response [$F(1,68) = 7.11$, $p < .01$] and the interaction term between early response and nonverbal $synchrony_{s3}$ [$F(1,68) = 4.64$, $p = .04$] were significant predictors of treatment outcome, whereas nonverbal $synchrony_{s3}$ [$F(1,68) = .04$, $p = .84$] had no predictive value. Afterwards, the interaction effect was considered in detail via simple slope analysis. It was found that early response does not act as a moderator between nonverbal $synchrony_{s3}$ and the outcome as nonverbal $synchrony_{s3}$ is neither predictive in early responders ($Beta_{sync} = .04$, $t_{(68)} = 1.35$, $p = .18$) nor in initial non-responders ($Beta_{sync} =-.00$, $t_{(68)} =-.25$, $p = .80$). When nonverbal $synchrony_{s3}$ is considered the moderator in simple slope analysis, it shows that dyads with early responders have a significantly better outcome than dyads with initial non-responders when (centered) nonverbal $synchrony_{s3}$ is higher than -2.72. At the maximum level of nonverbal $synchrony_{s3}$ (value of 20), early response significantly positively predicts outcome (Beta = 1.49, $t_{(68)} = 2.34$, $p = .02$), whereas at the minimum level (value of -20), no group difference was found (Beta = -.31, $t_{(68)} = -.49$, $p = .63$), see Figure 2.

A similar pattern could be found when nonverbal synchrony was measured in s8 (early response [$F(1,69.94) = 8.45$, $p < .01$], interaction early response x nonverbal $synchrony_{s8}$ [$F(1,69.93) = 8.65$, $p < .01$], nonverbal $synchrony_{s8}$ [$F(1,70) = 2.21$, $p = .14$]) and s20 (early response [$F(1,42) = 9.09$, $p < .01$], interaction early response x nonverbal $synchrony_{s20}$ [$F(1,42) = 4.40$, $p = .04$], nonverbal $synchrony_{s20}$ [$F(1,42) = .22$, $p = .64$]), see Table 3. When nonverbal synchrony was measured in s30, multilevel modelling showed that neither early response [$F(1,21.94) = 2.12$, $p = .16$], nor the interaction term between early response and nonverbal $synchrony_{s30}$ [$F(1,21.91) = 2.58$, $p = .12$], nor nonverbal $synchrony_{s30}$ [$F(1,21.08) = 2.09$, $p = .16$] were predictors of outcome.

7.5 Discussion

Early response has repeatedly been shown to be predictive of successful therapy across a wide variety of therapeutic approaches (e.g., Hofmann et al., 2006; Renaud et al., 1998) and different fields of medicine (e.g., Guler-Uysal & Kozanoglu, 2004; Houssiau et al., 2004). In psychotherapy research, early response is associated with fewer symptoms at therapy termination and higher maintenance of therapy gains (e.g., Haas, Hill, Lambert, & Morrell, 2002). Whereas the predictive value of early response for treatment outcome has repeatedly been confirmed, very little is known about the linking mechanisms (Stulz, Lutz, Leach, Lucock, & Barkham, 2007). So far, it has been assumed that early response leads to an improvement of the therapeutic relationship (Tang & DeRubeis, 1999), which may enhance treatment outcome. Another linking factor may be nonverbal synchrony, which has been shown to be associated with process factors such as the therapeutic relationship (e.g., Koole & Tschacher, 2016) and to be predictive of outcome (e.g. Paulick et al., in press). Nonverbal synchrony opens new doors with regard to nonverbal aspects of therapeutic processes/change that have been difficult to measure so far. In particular, for patients with social phobia, who are known to display characteristic nonverbal patterns, it may be a helpful tool to better understand the effects of early response. Therefore, the present study investigated associations between early response, nonverbal synchrony and outcome in cognitive-behavioral therapy for patients with social phobia.

Contrary to our hypothesis, we found no group difference between dyads with early responders and initial non-responders with regard to nonverbal synchrony at the beginning of therapy, revealing that nonverbal synchrony may have no predictive value for early response. Furthermore, we found no effects of early response on nonverbal synchrony during the course of therapy. One explanation may be that the subsequent improvement of the therapeutic relationship (Tang & DeRubeis, 1999) is not reflected in an increase of nonverbal synchrony, as the two constructs measure different aspects of relationship quality (Paulick et al., in press). Whereas the therapeutic relationship is usually measured using survey data, nonverbal synchrony is rather focused on nonverbal aspects of accordance that are hardly verbally assessed. Another explanation may be that therapists balance the nonverbal relationship offered to them by their patients after an early response. Whereas therapists may support increased autonomy after an early response in more submissive patients, they may equally support avoidant patients in opening up after an early response (Stravynski, Kyparissis, Amado, Hoffmann, & DiBartolo, 2010) – resulting in comparable levels of nonverbal synchrony. Nonetheless, much more research is necessary to understand these mechanisms.

In line with our second hypothesis, we found that nonverbal synchrony decreased over the course of therapy. This result is in line with a former study showing a decrease in nonverbal synchrony over the course of therapy for anxiety disorders, which is discussed as a reduction of the exaggerated attention focus on external cues and an enhanced perception of internal experiences (Paulick et al., 2017). For patients with social phobia, it may reflect an attention shift from focusing on their effect on others to focusing on their own feelings and needs, an aim in psychotherapy. In this context, it may also be related to the reduction of submissive and over-adapting behavior, which is also present in social phobia and aimed to be reduced in psychotherapy (Wells, 2013).

Finally, after confirming the predictive value of early response on outcome, we found an interaction effect between early response and nonverbal synchrony (measured at the first three times of assessment) on treatment outcome. It detail, it was found that the difference in outcome between early responders and initial non-responders was positively associated with nonverbal synchrony in s3, s8 and s20, while controlling for the therapeutic relationship. For low levels of nonverbal synchrony, no group differences could be found and in s30, the interaction effect was no longer existent. These results reveal that nonverbal synchrony, measured in early stages of psychotherapy, acts as a moderator between early response and outcome. This is in line with former studies revealing a positive relationship between nonverbal synchrony (measured early in therapy) and therapeutic outcome (Paulick et al., in press; Ramseyer & Tschacher, 2011). So far, nonverbal synchrony is considered a nonverbal measure of accordance, sympathy and relationship quality (e.g., Chartrand & Bargh, 1999; Grammer, Honda, Juette, & Schmitt, 1999), going beyond questionnaire ratings of the therapeutic relationship (Paulick et al., in press). This nonverbal accordance between patients and their therapists, which is not easily consciously assessable, may be especially important in earlier stages of psychotherapy to facilitate the positive development of patients with social phobia.

Limitations

The first limitation refers to the sample size; in particular, the group of early responders only consisted of 38 patients. It is conceivable that we did not find interaction effects between nonverbal synchrony (measured in s30) and early response on treatment outcome as a result. On the other hand, the limitation of our sample size was mainly due to the inclusion of patients with social phobia only. This was especially important to us, as we expected unique movement patterns in these patients, which may change during the course of therapy and therefore provide further information on symptomatic change.

Another limitation refers to the measurement of nonverbal synchrony itself. The applied measurement provides information on the frequency of nonverbal synchronization. However, there are many different ways of defining and measuring nonverbal synchrony, which complicates the comparability of research results (e.g., Altmann, 2011; Boker, Rotondo, Xu, & King, 2002; Ramseyer & Tschacher, 2014). Furthermore, the applied automated measurement of nonverbal behaviour only captures simultaneous movements of interacting persons, regardless of whether these movements are related to each other in terms of content. On the other hand, many former studies in social and developmental psychology research were able show reliable and promising results using these automated measurements (e.g., Watanabe, 1983; Grammer, Honda, Juette, & Schmitt, 1999; Tschacher, Rees, & Ramseyer, 2014).

Conclusion and Future Directions

This study investigated associations between early response, nonverbal synchrony and outcome in patients with social phobia. It was found that nonverbal synchrony acts as a moderator between early response and therapy outcome. The findings demonstrate that nonverbal aspects of the therapeutic relationship provide further important information on nonverbal features of diagnostic groups and therapeutic processes. The results highlights the importance of accordance between patients (especially those with social phobia) and their therapists for outcome. This finding is in line with numerous studies demonstrating that the therapeutic relationship is predictive of therapy outcome (e.g., Flückiger, Del Re, Wampold, Symonds, & Horvath, 2012; Orlinsky, Rønnestad, & Willutzki, 2004).

With further knowledge of these associations between nonverbal synchrony and therapeutic success, it may prospectively be possible to improve treatments and avoid therapy failures such as dropout, non-improvement or deterioration. It is conceivable that the feedback of nonverbal synchrony to therapists may be a helpful supplemental tool to make them more aware of nonverbal processes. In further studies, it may therefore be interesting to investigate whether these results also hold for other mental disorders and other operationalisations of treatment outcome.

7.6 Tables and Figures

Table 1

Sample characteristics

Variable	Early responders (N=38)		Initial non-responders (N=73)	
	Mean or %	Range or N	Mean or %	Range or N
Patient age (years)	32.4	18-60	34.6	15-60
Patient sex (female)	36.8	14	47.9	35
Therapist age (years)	31.2	24-51	30.6	24-51
Therapist sex (female)	78.9	30	89.0	65
Therapy duration (sessions)	43.0	12-94	42.5	7-87
Dropout frequency	18.4	7	23.3	17
Marital status				
Living in partnership	44.7	17	64.4	47
Education				
General qualification for university entrance	39.5	15	52.1	38

Table 2

Fixed effects for random intercept model examining the associations between nonverbal synchrony, early response, and times of assessment

Fixed effects	Parameter estimates	Std. error	t value	p
Intercept	25.83***	1.19	21.65	.000
Early response	-.17	1.90	-.09	.93
s8	-2.33	1.46	-1.60	.11
s20	-4.56**	1.71	-2.66	.008
s30	-6.56***	1.82	-3.62	.000
Early response x s8	-.74	2.50	-.30	.77
Early response x s20	-.65	2.84	-.23	.82
Early response x s30	-1.28	3.19	-.40	.69

Note: S3 was set as the intercept for each time of assessment.

Table 3

Parameter estimates (and standard errors) for mixed effects models examining the associations between outcome (BSI_int change scores), early response, and nonverbal synchrony (when controlling for the therapeutic relationship)

Fixed effects	Model 1	Model 2 (s3)	Model 3 (s8)	Model 4 (s20)	Model 5 (s30)
Intercept	.65***	.65***	.68***	.68***	.73***
	(.13)	(.13)	(.13)	(.16)	(.17)
Early response	.63**	.59**	.65**	.80**	.45
	(.22)	(.22)	(.22)	(.27)	(.31)
Nonverbal synchrony		-.00	-.02	-.01	-.03
		(.01)	(.01)	(.01)	(.02)
Early response x Nonverbal synchrony		.05*	.08**	.06*	.05
		(.02)	(.03)	(.03)	(.03)
Therapeutic relationship (HAQ)		-.19	-.14	-.38[t]	-.04
		(.18)	(.18)	(.21)	(.32)
AIC	214.65	207.91	213.07	133.34	72.05

Note: HAQ = Helping Alliance Questionnaire (subscale relationship). Nonverbal synchrony and the therapeutic relationship were centered for analysis. Nonverbal synchrony was measured at session 3 in Model 2, session 8 in Model 3, session 20 in Model 4 and session 30 in Model 5. Therapeutic relationship was each measured in temporal proximity (maximum deviation of +/- 1 session) to the measures of nonverbal synchrony.

[t] $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$

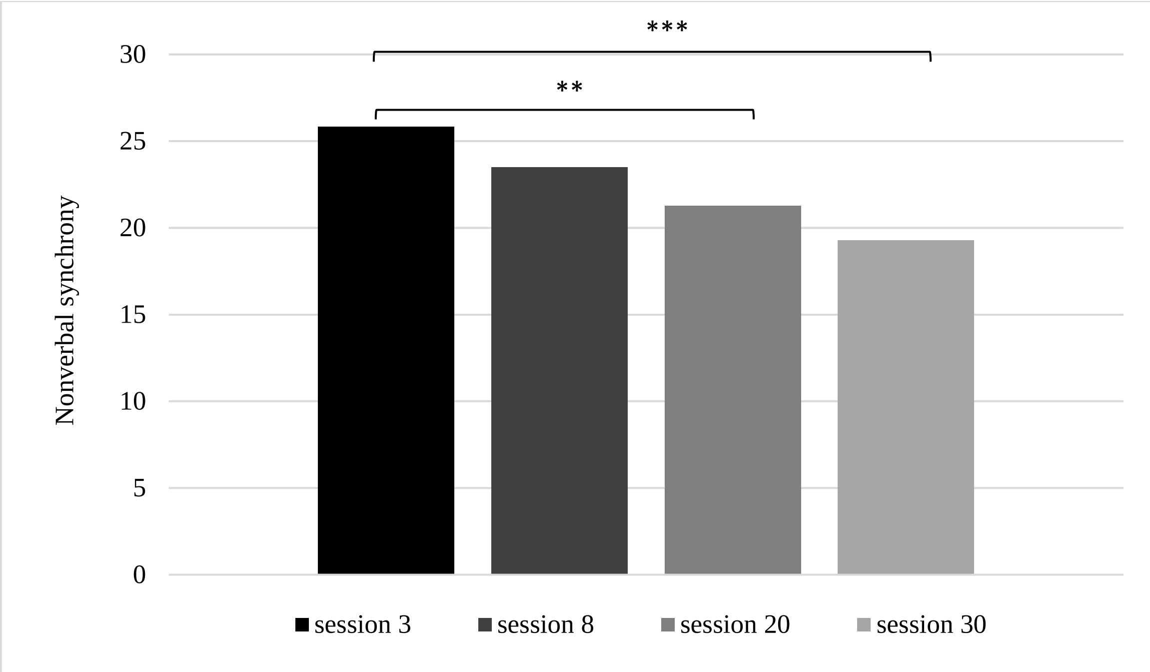

Figure 1. Results from multilevel modelling investigating the main effect of time of assessment (main effects of s8, s20, s30 with s3 as the reference category) on nonverbal synchrony. Significant main effects in mixed models are marked by $p < .01$**, $p < .001$***.

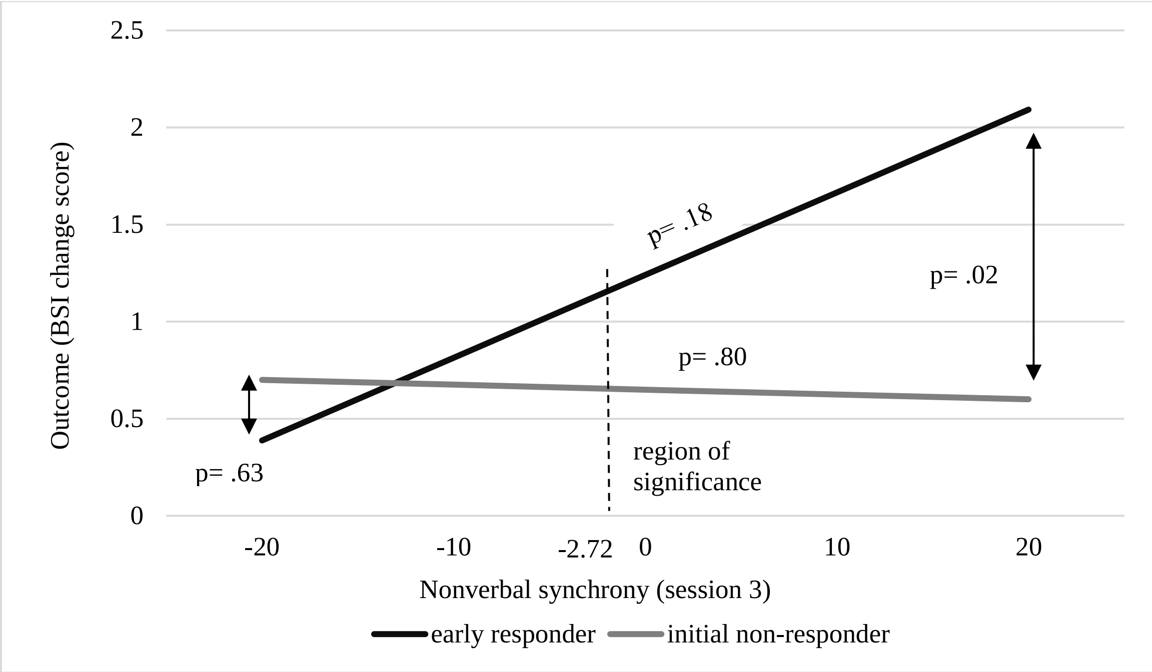

Figure 2. Estimated regression slopes from multilevel modelling with simple intercept and slope analysis for the interaction between early response and (centred) nonverbal synchrony$_{s3}$ on outcome (when controlling for the centred therapeutic relationship measured in temporal proximity to the measure of nonverbal synchrony).

7.7 Study III: References

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8 General Discussion

The three summarized studies aimed at filling existing research gaps with regard to nonverbal synchrony in outpatient psychotherapy. Associations between nonverbal synchrony, the therapeutic relationship, symptom reduction (early response, treatment outcome), drop-out and diagnostic features were taken into account.

Study 1 aimed to replicate and expand Ramseyer and Tschacher's (2011) findings and after confirming the validity of the applied video-based procedures, it investigated associations between nonverbal synchrony, the therapeutic relationship and treatment outcome. Although no association with the therapeutic relationship was found, a relation to special outcome types was observed: Patients with improvement showed a medium level of nonverbal synchrony, patients with non-improvement and drop-out showed the lowest level and patients with non-improvement and consensual termination the highest level of nonverbal synchrony.

In study 2, the focus was on diagnostic differences in nonverbal synchrony and dyads with patients suffering from depression and anxiety were compared (with regard to movement quantity and nonverbal synchrony). At the beginning of therapy, movement quantity and nonverbal synchrony (when controlling for movement quantity) were lower in depressive than in anxious patients. Nonverbal synchrony adapted during the course of therapy and at the end both groups reach comparable levels.

Study 3 investigated nonverbal synchrony in dyads with patients with social phobia. Nonverbal synchrony was measured at four times (covering a short term therapy) and decreased during the course of psychotherapy. Nonverbal synchrony further moderated between early response and therapy outcome (in patients with higher levels of nonverbal synchrony in early stages of therapy, the effect of early response on outcome is greater).

8.1 General Conclusion

Taking all three studies together, some general conclusions about nonverbal synchrony in outpatient psychotherapy can be drawn.

First, no association was found between nonverbal synchrony and the therapeutic relationship measured via patient-rated survey data (study 1). This result does not support previous findings concerning nonverbal synchrony in psychotherapy (Ramseyer & Tschacher, 2011, 2014). However, some methodological limitations must be stated. First, different psychometric instruments were used, as Ramseyer and Tschacher (2011, 2014) used the Bern Post-Session Report (Flückiger, Regli, Zwahlen, Hostettler, & Caspar, 2010) and in study 1, the HAQ (Alexander & Luborsky, 1986; German translation by Bassler, Potratz, & Krauthauser, 1995) was applied. Second, nonverbal synchrony was measured in temporal proximity, but not always exactly in the same sessions as the therapeutic relationship (because of issues of appropriateness for video analysis). It is conceivable that changes in nonverbal synchrony or in the rated therapeutic relationship took place in the sessions between these measurements. Third, Ramseyer and Tschacher (2011, 2014) only investigated same-sex dyads, which have shown to display special patterns of nonverbal behavior and synchrony in some studies (Grammer, Kruck, & Magnusson, 1998; La France & Ickes, 1981; Namy, Nygaard, & Sauerteig, 2002), but not in all (Koss & Rosenthal, 1997). For the purpose of generalizability, study 1 included same- and opposite-sex dyads, whereas no dyad-type differences were found (in study 1 and also study 2). Interestingly, study 1 and also study 3 found relations between nonverbal synchrony and measures of therapeutic success (relations between early response and outcome, outcome-types referring to drop-out and reliable change) even when controlling for the therapeutic relationship. Both studies revealed that measures of nonverbal synchrony go beyond the applied psychometric instruments for the assessment of the therapeutic relationship. Nonverbal synchrony may therefore be considered a measure of nonverbal aspects of the relation between patients and therapists that are hard to assess verbally as they may not be subject to conscious perception. Nonverbal synchrony may represent more basic, naturally occurring unconscious forms of sympathy and liking. Nevertheless, much more research on the concrete relations between nonverbal synchrony and the therapeutic relationship in outpatient psychotherapy is needed.

Second, nonverbal synchrony was associated with drop-out and treatment outcome as an inverted u-shaped relation between nonverbal synchrony and outcome was found, emphasizing a medium level of nonverbal synchrony at the beginning of therapy being advantageous for treatment success (study 1). This finding has been complemented by the results of study 3, which indicate that a higher level of nonverbal synchrony enhances the effect of early response on outcome (in a sample of patients with social phobia). Previous studies came to comparable results as they also revealed positive associations between nonverbal synchrony and therapeutic success (e.g., Ramseyer & Tschacher, 2011, 2014). Taken together, the studies included emphasize that the relations between nonverbal synchrony and treatment outcome seem to be influenced by patient characteristics such as diagnoses and change patterns. It is conceivable that a medium level of synchrony is beneficial in a disorder-heterogeneous sample, because it includes patients with diagnoses characterized by high levels of adaptation (e.g., social phobia, anxious-avoidant personality disorder) as well as by low levels of adaptation (e.g., narcissistic personality disorder, severe depression). Following this idea, when only patients with social phobia are taken into account, it makes sense that not only early symptom reduction enhances therapy outcome, but also early response together with higher levels of nonverbal synchrony.

Third, diagnosis had an impact on nonverbal synchrony as depressive patients had lower levels of nonverbal synchrony at the beginning of therapy in comparison to patients with anxiety disorders. During the course of therapy, nonverbal synchrony became more moderate in both groups, resulting in them no longer differing at the end of therapy. These results were found even when controlling for movement quantity, which also differed between both diagnostic groups and was considered a measure of psychomotor inhibition/agitation (study 2). Furthermore, in a disorder-homogenous sample of patients with social phobia, a general decrease in nonverbal synchrony was found (study 3). Studies on diagnostic differences in nonverbal synchrony are rare so far. Recent studies have merely investigated associations between nonverbal synchrony, symptomatology and symptom reduction in disorder-homogenous groups of schizophrenic patients (e.g., Galbusera et al., 2016; Kupper et al., 2015).

8.2 General Limitations and Future Research

Besides the above-mentioned findings, some general limitations must be addressed. A methodological limitation refers to the calculation of nonverbal synchrony. In studies 1 and 2, nonverbal synchrony was computed by averaging cross-correlations of segmented time-series, whereas, in study 3, it was calculated by computing the proportion of significant cross-correlations (by testing against zero and applying a peak-picking algorithm) in the total video sequence analyzed. Both methods have the similarity that nonverbal synchrony was calculated using cross-correlations between time series (which were adjusted for spurious correlations), but they differ concerning their operationalization. The values in studies 1 and 2 represent the amount of averaged nonverbal synchrony, whereas the values in study 3 represent the frequency of significant synchronous intervals. Previous studies have found that different kinds of time series analysis methods show diverging levels of nonverbal synchrony in the same databases (Thielemann et al., 2017). On the other hand, studies have found comparable results using different operationalizations of nonverbal synchrony so far (e.g., Altmann, 2011; Grammer et al., 1999), indicating that despite diverse underlying definitions and operationalizations, all are connected to one content-related construct they aim to measure.

Another limitation refers to the interpretation of nonverbal synchrony as these global values provide no information on the direction of the synchrony process. One does not know whether the therapist or the patient is the initiator of each synchronized movement. However, this may be especially interesting and of importance to furthering the understanding of the meaning of nonverbal synchrony (e.g., it makes a clear difference whether nonverbal synchrony is high because the patient follows every movement of his therapist or because the therapist follows his patient). Consequently, more research on the phenomena of *leading* and *pacing* (terms first introduced in this context by Ramseyer and Tschacher, 2011) is necessary.

Furthermore, much more investigation of diagnostic differences in necessary as recent studies (e.g., Kupper et al., 2015) and the ones included (study 2 & 3) have revealed that patient diagnosis has an influence on the level of nonverbal synchrony. In studies of diagnosis-heterogeneous samples, patient diagnosis should be taken into account.

In the future, it is conceivable that nonverbal synchrony could be reported back to therapists. In detail, when the feedback is provided in the early stages of psychotherapy (possibly directly after the first session(s) of treatment), it may represent a measure of nonverbal aspects of the therapeutic relationship (a *nonverbal first impression*) and may be used for early prediction of drop-out and future treatment success. When provided during the course of therapy, it may provide additional information on patient symptomatic change (concerning the ability to get in contact with others). As previous studies in patient-focused psychotherapy research have revealed that the feedback of patient symptomatic change and the therapeutic relationship can improve therapeutic adaptation and lead to better outcomes (e.g., Lambert, Harmon, Slade, Whipple, & Hawkins, 2005; Lutz et al., 2015), further studies should investigate whether the feedback of nonverbal synchrony to therapists may have a positive effect on treatment success.

On the other hand, in the context of growing research interest in embodiment (e.g., Tschacher et al., 2017), future studies should also investigate effects of therapeutic techniques focused on nonverbal synchrony (e.g., therapist and patient walk or breath in synchrony for 5 minutes) on the therapeutic relationship and treatment outcome. Again, it is conceivable that there are diagnosis-specific effects as, for instance, patients displaying social avoidance (e.g., depression, social phobia) may benefit from these techniques, whereas patients with a greater need for autonomy (e.g., narcissistic personality disorder) may not profit.

8.3 Concluding Remarks

Despite the above-mentioned limitations, the present dissertation aims to fill previous research gaps referring to nonverbal aspects in psychotherapy and demonstrates the potential of nonverbal synchrony for improving therapeutic success in outpatient psychotherapy. Taking all three studies together, results suggest that the assessment of nonverbal synchrony provides additional information on therapeutic progress and its feedback to therapists may be a helpful supplement for the early detection of patients at risk for treatment failure. Nonverbal synchrony may constitute a new, nonverbal, personalized prediction and adaptation tool in patient-focused psychotherapy research, helping to further understand what works for the individual patient and why.

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Eidesstattliche Erklärung

Ich versichere, dass ich meine Dissertation ohne Hilfe Dritter und ohne Benutzung anderer als der angegebenen Quellen und Hilfsmittel angefertigt und die den benutzten Quellen wörtlich oder inhaltlich entnommenen Stellen als solche kenntlich gemacht habe. Diese Arbeit hat in gleicher oder ähnlicher Form noch keiner Prüfungsbehörde vorgelegen.

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